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ABSTRACT

This guide contains materials for a general construction course. Introductory materials include a list of videos, schedule for the 10-day course, and tools and material list. The course is divided into 10 sections. Each section consists of some or all of these components: list of trainee objectives, instructor notes, instructor outline, instructional/informative materials, assignment sheet(s), and review quiz. The 10 sections cover the following topics: craft orientation; material recognition; hand tools; safety; power tools--gas/electric/pneumatic/powder activated; compaction; hand signals; knots and rigging; cutting and burning; and introductory industry math. Answer keys to review quizzes follow Section 10. Contents of attachments are as follows: a publication with course overviews of 10 construction skills courses, 7 environmental courses, 3 refresher courses, and 6 supervisory courses and news releases that focus on a learn-at-home program to improve reading skills. (YLB)

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ED 379 422

Laborers-AGC Construction Skills Training Programs

General Construction

Section I
Craft Orientation

Section II
Material Recognition

Section III
Hand Tools

Section IV
Safety

Section V
Power Tools - Gas/Electric/Pneumatic/Powder Actuated

Section VI
Compaction

Section VII
Hand Signals

Section VIII
Knots and Rigging

Section IX
Cutting and Burning

Section X
Introductory Industry Math

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

CE 068 102

VIDEOS FOR GENERAL CONSTRUCTION

Section I		
	Making It Work	L-AGC
	Foundation for Success	L-AGC
	Responding to the Need	L-AGC
Section IV		
	Caught in Time	AGC
	Success at the Top	AGC
	Clearing the Air	AGC
	Excavation	L-AGC
	An Awareness Program in Hazard Recognition	Ontario
	The Choice is Yours	AGC
	Working at Heights Safely	L-AGC
TIPS AV15	The Mechanics of Lifting, Prying and Moving Objects	
Section V		
TIPS AV3	Small Gas Engines	
TIPS AV12	Safe Chainsaw Operation and Maintenance	
TIPS AV5	Portable All-Purpose Saws	
TIPS AV1	The 90-Pound Pavement Breaker	
TIPS AV9	Chipping Guns and Grinders	
TIPS AV18	The Jackhammer	
TIPS AV2	Compressor: Operation, Maintenance, and Safety	
TIPS AV4	Concrete Vibration	
Section VI		
TIPS AV8	Soils and Compaction	
Section IX		
TIPS AV10	Oxy-Acetylene Cutting	
Section X		
	Basic Method Used in the Transfer of Grade Points	

GENERAL CONSTRUCTION SCHEDULE

Day 1:

8:00-8:30	Introduction, rules and regulations, paperwork
8:30-11:00	Craft Orientation
11:00-12:00	Material Recognition - lumber, fasteners, fuels, and fluids
Lunch	
12:30-1:30	Material recognition - reinforcing identification and rebar tags
1:30-2:30	Hand tool identification and use
2:30-4:30	Safety - hazard recognition and safety awareness, correct lifting procedures, workplace rights

Day 2:

8:00-12:00	OSHA Regulations - general and specific - films
Lunch	
12:30-3:00	Hazard Communication
3:00-4:30	Gas powered tools - small gas engines - operation, safety, fuels and fluids, and maintenance

Day 3:

8:00-12:00	Gas powered tools - all purpose saws, chain saws, other gas-powered tools - hands-on demonstrations Electric powered tools - maintenance and operation, safety precautions, hands-on demonstrations
Lunch	
12:30-4:30	Hand-on training with gas and electric powered tools, cleanup

Day 4:

8:00-12:00	Pneumatic powered tools - identification and uses, maintenance and operation, safety precautions, compressor operation, hands-on demonstrations
Lunch	
12:30-4:30	Hands-on training with pneumatic powered tools

Day 5:

8:00-11:00	Continue hands-on training with pneumatic tools, clean up
11:00-12:00	Soils and compaction - soil types and moisture content, equipment operation and maintenance
Lunch	
12:30-3:00	Hands-on demonstration and training with compaction equipment - placing lifts and compacting with different moistures, etc.
3:00-4:30	Site clean-up, equipment storage, etc.

Day 6:

8:00-9:00	Review
9:00-10:00	Hand signals - identification of signals for different equipment
10:00-12:00	Knots, splices, and hitches - rigging with fiber rope
Lunch	
12:30-3:30	Rigging - wire rope, rigging hardware, slings, and chains rigging techniques and safety
3:30-4:30	Oxy-fuel cutting - equipment set-up, safety, operation and maintenance, demonstrations

Day 7:

8:00-12:00	Continue rigging and signaling practice, clean-up Continue oxy-fuel cutting practice, clean-up
Lunch	
12:30-4:30	Flagging and traffic control

Day 8:

8:00-4:30	First aid - CPR

Day 9:

8:00-12:00	Basic construction math
Lunch	
12:30-4:30	Horizontal and vertical measuring equipment and techniques

Day 10:

8:00-4:30	Horizontal and vertical measuring practice

GENERAL CONSTRUCTION
TOOLS AND MATERIAL LIST

SECTION I (Craft Orientation)

Classroom materials and videos

SECTION II (Material Recognition)

Display boards - nails and other fasteners
Rebar tags - rebar and other reinforcing
Display in workshop - fuel containers: gas, mixed gas, diesel

Set up on tables for identification: fuel containers: gas, mixed gas, diesel
fluids: motor oil, grease gun and cartridge
gear lube
2-cycle oil
funnels

Display lumber - 2x4's - 2x12's
Show dimensions - plywood
treated lumber
rough cut lumber

SECTION III (Hand Tools)

Display boards or tables

- hammers
- pliers
- chisels
- axes
- bits
- crowbars
- cutters
- files
- hacksaws
- hatchets
- jacks
- planes
- hand saws
- scrapers
- screwdrivers
- tin snips
- wrenches
- sockets
- shovels
- wheel barrows & buggies
- levels
- tape measures
- pin puller
- rakes

SECTION IV (Safety)

OSHA Materials - OSHA 2202
OSHA 3032
OSHA 1926

Videos
New Haz Comm Manuals

SECTION Va (Power Tools - Gas)

- all purpose saws
- chain saw - accessories
- water pump - hoses
- generator
- mixers-paddle and barrel
- LP heater
- salamander heater
- Briggs and Straton engine - to display and dismantle

SECTION Vb (Power Tools - Electric)

- circular hand saw
- hand drill
- saber saw
- saws-all
- rotary hammer (hammer drill)
- grinders
- ventilation fan

SECTION Vc (Power Tools - Pneumatic)

- Compressor - hoses, line oiler, gaskets, tanner gas, safety pins
- 90# breaker
- 60# breaker
- jackhammer
- chipping gun (2)
- clay spade and 30# gun
  - various bits for each above - moil point
    - chisel
    - 5" asphalt cutter
    - bushing tool

SECTION VI (Compaction)

- vibra-plate
- rammer
- pogo stick (air)
- walk behind roller

SECTION VII (Hand Signals)

Classroom materials and video

SECTION VIII (Rigging)

- 1 spool 3/4" manila rope - 600'
- nylon slings
- wire rope slings
- 1/2'" or 3/4" wire rope 200'-300'
- 3/8" or 1/2" chains with slip hooks and grab hooks
- wedge socket
- wire rope clips - 12
- thimbles
- hooks
- shackles
- turn buckles

SECTION IX (Oxy-Fuel Cutting)

2 torch sets with tanks - cutting attachments
strikers - different size tips - welding tips - rods - misc. steel for cutting practice
welding gloves
goggles
sleeves and aprons

Traffic Control

flags
sign paddles
vests

SECTION X (Math and Instruments)

folding rules
rag tapes
plumb bobs
2/4's for batter boards

auto levels
laser levels
transits
grade rods

calculators
stringline
hubs
steel stakes
lath

PROJECT TITLE

PROJECT NUMBER

Directory

Project Description

Manual Contents

Schedule and Log

Correspondence

SECTION I
CRAFT ORIENTATION

Trainee Objectives

Trainees should be taught to:

1. Develop good work habits to include: promptness, attitude, proper dress and good relationships with fellow workers.
2. Be productive: give a days work for a days pay.
3. Understand working under a collective bargaining agreement.
4. Be aware of industry projections for work in their area.
5. Understand LIUNA and its related funds.

CRAFT ORIENTATION INSTRUCTOR NOTES

Goal

The course is part of a comprehensive strategy to develop construction laborers who are qualified for a growing industry demand, informed about the industry and the union, and capable of making sound career decisions.

Trainees

The trainees are new entrants, experienced laborers, or young adults who are exploring a career in the construction industry.

Number of Trainees

Sixteen (16) - Twenty (20)

Content/Duration

The orientation is eight (8) hours and consists of the following modules and timeframes:

Module 1: Introduction (Pages 1 - 2) overviews the course goals, objectives and content of the remaining modules and involves the trainees in an icebreaker activity. (8:00 a.m. - 8:20 a.m)

Module 2: The Construction Industry (Pages 3 - 10) defines industry groups and the type of work performed, forecasts industry projections, and describes how the industry works, i.e., the purpose of contractor associations, the relationship among various contracting agencies, the chain of command at a project site, worker-employer responsibilities, the relationship between labor and management, and laborer job tasks and tools/machines. (8:20 a.m. - 10:30 a.m., Break 10:00 a.m. - 10:10 a.m.)

Module 3: The Construction Laborer Craft (Pages 11 - 16) lists the most frequent job tasks, highlights the major tools and equipment, identifies wage and benefit structures and related issues, and describes the benefits of unions. (10:30 a.m. - 2:00 p.m., Lunch 12:00 p.m. - 12:30 p.m.)

Module 4: The Laborers' International Union of North America (LIUNA) (Pages 17 - 18) traces how LIUNA evolved into its current mission, structure, benefits, and future direction. (1:00 p.m. - 3:10 p.m., Break 2:00 p.m. - 3:00 p.m.)

Module 5: Laborers-AGC Education and Training Fund (Pages 19 - 24 describes LIUNA's and the AGC's collaboration as a vehicle for continuous professional development. (3:00 p.m. - 4:00 p.m.)

Module 6: Summary (Page 25) recaps the key points and provides an opportunity for the trainees to consider a career as a laborer. (4:00 p.m. - 4:30 p.m.)

SECTION I
INSTRUCTOR OUTLINE (2-3 hours)

1. Discuss good work habits such as:
   a. Promptness - being on time or a little early for work to get work assignments, or for tool box meetings before work starts.
   b. Develop a good working attitude to include safety and pride in workmanship.
   c. Dressing properly for work.
   d. Discourage harassment of other workers and foremen.
2. Discuss being productive as contractors must get a day's work for a day's pay. Low productivity can force a contractor out of business and laborers out of jobs.
3. Discuss collective bargaining agreements.
4. Discuss what the construction has in store for future jobs.
5. Discuss LIUNA and its related funds.

INTRODUCTORY QUESTIONS

Before we begin Section One, answer the following questions:

1. What does the term "construction laborer" mean?

2. What does a construction laborer do? (Please answer in one sentence.)

3. Why do you want to be a construction laborer?

THE CONSTRUCTION INDUSTRY

The construction industry is one of the most diverse and rewarding industries in the world. From a single-family home, to a railway tunnel under the English Channel, the potential for personal and financial growth is only limited by your willingness to work and learn. A career in construction can provide a good standard of living for you and your family, as well as a sense of pride and accomplishment in the projects you help to build.

Major Construction Industries

It is beyond the scope of this document to list all of the major types of construction. Therefore, we will identify and group them into the following categories:

Building

Construction and reconstruction on residential and commercial buildings.

Highway

Construction and reconstruction on major and minor highways, subdivision streets, bridges, tunnels, or airfields.

Utilities

Construction and renovation on underground utilities and piping systems, such as petroleum, water, sewer, telephone, electric, and natural gas distribution and collection systems.

Environmental

Clean up and restoration associated with hazardous waste removal, nuclear remediation, underground storage tanks, as well as asbestos and lead abatement.

Required Skills for Each Construction Industry

Construction laborers are not the "all-brawn and no-brain" workers that the name implies. In addition to the physical demands of the job, they perform critical tasks that require specialized thinking and technical skills.

The **building** industry requires laborers to be skilled in:

- Reading and correctly interpreting blueprints and project specifications.
- Setting and controlling elevations, aligning foundations, and other building structures using laser levels, builders levels, and transits.
- New and old technologies for concrete placement.

The **highway** industry requires laborers to be skilled in:

- Reading and correctly interpreting blueprints and project specifications.
- Working with elevation and alignment control instruments.

- Calculating volumes and area of complex shapes.

The **utility** industry requires laborers to be skilled in:

- Setting up lasers for alignment and elevation control.
- Reading and correctly interpreting blueprints and project specifications.
- Calculating volumes and quantities.
- Installing some of the most complicated utility systems in the world.

The **environmental** clean up industry requires laborers to be skilled in:

- Working with existing and potential hazards at the work site.
- Chemistry and industry specific training, so the worker can operate the most modern testing and analysis equipment. (This training is required only if workers are assigned to the testing and evaluation stage of the project.)

How Much Work is Available?

Construction remains a major growth industry in North America and a source of jobs for new entrants into the work force. Construction jobs are growing at a steady pace. The United States Bureau of Labor Statistics (BLS) predicts construction jobs will grow from 760,000 to 1.2 million in this decade. These growth areas are shown in Figure 1-1.

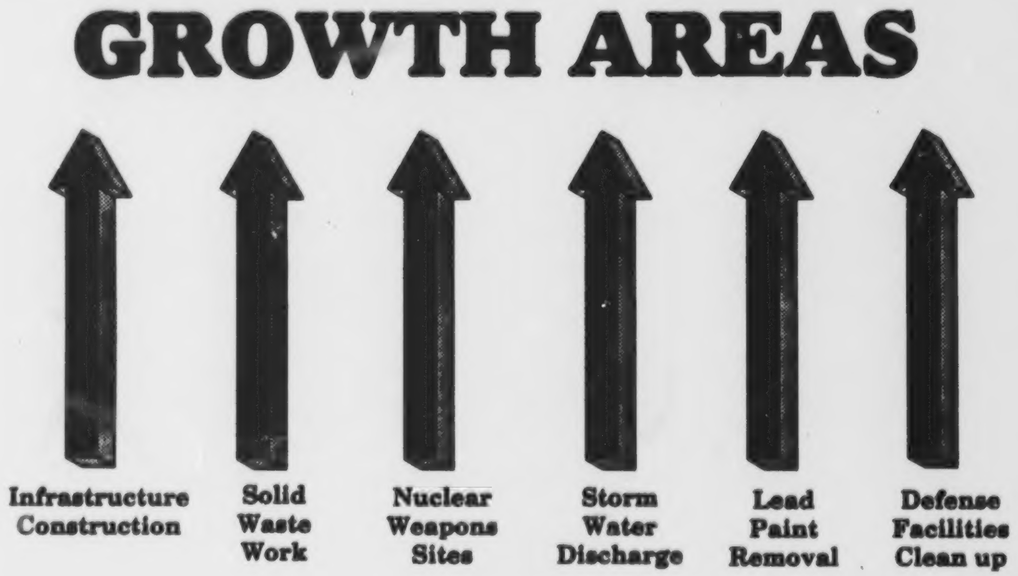
GROWTH AREAS
Infrastructure Construction
Solid Waste Work
Nuclear Weapons Sites
Storm Water Discharge
Lead Paint Removal
Defense Facilities Clean up

Figure 1-1
Growth Areas

Building Projections

Annual construction spending is increasing, even though non-residential building, commercial construction, and office construction is declining. Annual construction spending dipped as low as 393.3 billion in June 1991, but increased to 406.3 billion in November 1991. Industrial and public construction remain steady at rates substantially higher than the late 1980s. Businesses plan to spend $558.6 billion on plants and equipment in 1992, which is a 5.4% increase over 1991.

Also, upward trends are beginning in single-family and multi-family home building, and in the environmental construction industry. Even though they are still lower than the late 1980s, they are moving in the right direction. The mid-90s could be a growth period with housing and public construction leading the way. (Constructor, January, 1992, p. 11; October 1992, p. 76)

Highway Projections

President Clinton has repeatedly called for major infrastructure work across the nation. After entering office, President Clinton renewed support for the Intermodal Surface Transportation Efficiency Act of 1991. It is the most significant federal legislation since the creation of the Interstate Highway System in 1956. The new six-year authorization potentially provides $151 billion for highway and bridge construction. This represents a significant increase in federal investment to help address the nation's well documented highway and bridge needs. The Federal Highway Administration reported in July that a $74.9 billion annual investment is required by all levels of government to improve the condition of the nation's roads and bridges.

The Administration estimates that this Act will generate or extend nearly 600,000 jobs. The Act further provides $6 billion for large urban areas to meet the requirements of the Clean Air Act. For bridge construction, $16.1 billion is provided to continue the existing bridge program. For airport construction, funding is set at $1.9 billion, a $100 million increase from last year. (Constructor, January 1992, p. 13)

Utility Projections

The Environmental Protection Agency (EPA) State Revolving Loan Fund should provide some increased stimulation in the municipal-utilities market. Congress has improved fiscal year 1992 appropriations in the amount of $1.95 billion. In addition, Congress has directed grant funding to construct waste water treatment facilities in eight cities. This funding represents an increase of $300 million over the amount appropriated in fiscal year 1990. The amount of money spent on drinking water facilities is expected to increase in 1992. EPA recently issued a new set of standards for maximum contamination levels. As a result, utilities are expected to increase spending in 1992 to upgrade their facilities to meet these standards.

Although not a traditional segment of the utility construction market, hazardous waste clean up is becoming more attractive to utility contractors. In 1992, this market should provide many opportunities. The Superfund program will be funded at $1.6 billion for fiscal year 1992, the same level as 1991, but EPA intends to significantly increase the number of sites on which actual clean up activities are started. Stung by reports of mismanagement, EPA has initiated a plan that will lead to the completion of clean up activities on 140 sites by the end of 1992, 200 sites by the end of 1993, and a minimum of 650 sites by the end of 2000.

Fiscal Year 1992 will also see significant hazardous waste remediation starting at the facilities of the Department of Defense and Department of Energy. Congress recently passed the Department of Defense Authorization Bill, which increased funding for environmental restoration work at defense facilities to $1.18 billion in fiscal year 1992, from $1.06 billion in fiscal year 1991. The Bill also provides $3.7 billion for environmental restoration and waste management at defense facilities. Weapon waste storage and remediation will make up the largest share of the Department of Energy's budget by 1994. Congress is about to complete legislation that would require all federal facilities to comply with existing environmental requirements. This will inevitably lead to additional clean up activities. (Constructor, January 1992, p. 14; Engineering News - Record, October 1992)

Environmental Projections

The Superfund Amendments and Reauthorization Act of 1986 (SARA), coupled with the development of Occupational Safety and Health Act (OSHA) Worker Protection Standard, mandates certification requirements for Environmental workers who are, or will be, employed on hazardous waste clean up projects. Environmental clean up (i.e., hazardous waste removal, asbestos and lead abatement, and nuclear remediation) will continue to be done by a sector of the construction industry. As such, environmental clean up will rival traditional sectors, such as highway and building.

In the 1990s, the demand for Environmental workers will continue to grow dramatically. Environmental clean up is rapidly expanding and encompassing a huge range of individual sites bounded on one end by 52 million lead paint contaminated residential units, and on the other end by 1,200 of the worst hazardous waste sites. The clean up of hazardous materials and specific toxics, such as lead or radiation will require the expenditure of hundreds of billions of dollars over decades. The number of hazardous waste sites now identified continues to increase. The initial estimate of more than 30,000 sites is likely to be exceeded as more and more are identified for clean up.

The EPA has identified more than 1,200 hazardous waste sites and has cleaned up less than 100 sites. The Department of Defense has stated that more than 17,000 sites exist on active and abandoned military bases. Also, the Department of Energy has identified more than 1,700 separate sites connected with its nuclear weapons programs. The Department of Energy clean up program is expected to be given the first contract for the clean up of a uranium production site. The EPA is clearing the way for the construction of state-of-the-art municipal landfills whose permit has been held up until now. The agency estimates spending $330 million per year. In general, the solid waste market (i.e, land filling, waste-to-energy recycling, waste minimization) is projected to grow from a $30 billion industry at a 15 to 20% annual rate over the next several years. Congress is working on changes related to waste minimization, recycling, and toxics reduction. The EPA has estimated annual compliance costs to amount to $8 billion by the year 2000. There are a number of Clean Water Act storm water discharge regulations which will help sustain a growing environmental marketplace. Hazardous waste management costs will amount to $24.25 billion by 1995 and $41.5 billion by the year 2000. (Environmental Career Opportunities, November 25, 1991)

Construction Administration

Construction projects can be set up and coordinated in several different ways. However, every owner or contractor must follow a basic structure or standard. Each company should have a:

- Project Owner
- Project Administrator
- Architectect or Engineer
- Prime Contractor
- Subconstractor

Most owners or contractors follow this structure when building mega-projects. Many construction companies, as well as architectural and engineering firms are involved in this process. Even small companies that build backyard patios find it easier to complete a job when they follow this basic pattern.

The Project Owner

The project owner is responsible for originating and/or funding the project. For example, on a state highway job, the project owner is the state highway department, and on a municipal project, the municipality is the project owner. The project owners can contract with a project management and architectural or engineering firm to design and administer the project, or they can assume that role themselves. However, when the project is large with a complex design, the owner will often have an experienced project management company, as well as an architectural or engineering firm perform this role.

Project Administrator

Administration firms specialize in project design. To be effective in this role, they need to be knowledgeable in project design and construction techniques. The project administrator is often responsible for paying contractors for work completed, managing the large amounts of construction documents that are a part of every project, and ensuring that the other organizations are coordinating their efforts to complete the project. They usually organize frequent meetings between the other companies to review progress and to discuss problem areas. (Figure 1-2) Project owners can have their project designed by an architectural or engineering firm. Owners can also choose an administration firm that specializes in project design.

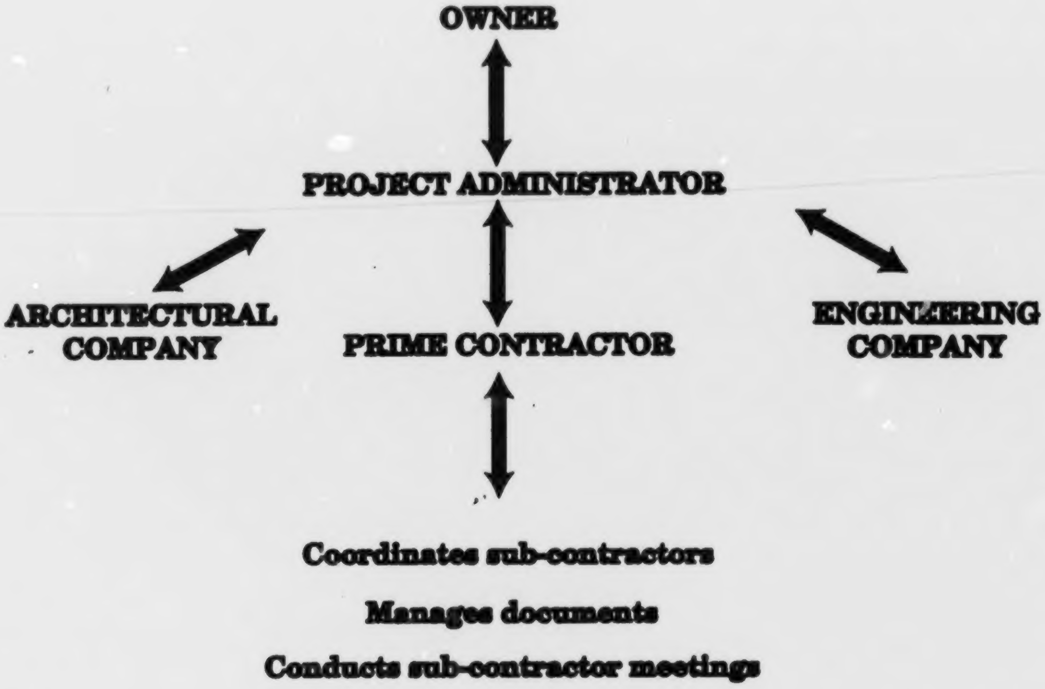
OWNER
PROJECT ADMINISTRATOR
ARCHITECTURAL COMPANY
PRIME CONTRACTOR
ENGINEERING COMPANY
Coordinates sub-contractors
Manages documents
Conducts sub-contractor meetings

Figure 1-2
Project Structure

The top 10 construction management (administrators) in the world are:

1. Fluor Daniel Inc.
2. Brown & Root Inc.
3. Bechtel Group Inc.
4. The Parsons Corp.
5. M. W. Kellogg Co.
6. ABB Lummus Crest Inc.
7. The Turner Corp.
8. Ebasco Services, Inc.
9. Jacobs Engineering Group Inc.
10. John Brown E & C Inc.

These administrators were "at risk" which means they have financial responsibilities and risks similar to a general contractor. This top 10 list is different than the "for fee only" administrator list. The "for fee only" managers provide their services for a professional fee, and they don't take any risks. (ENR, June 1993)

Architect or Engineer

The architectural or engineering firm provides the project design and is usually responsible for ensuring that the project is built to the design specifications. This means that the project inspectors and testing companies are often employed by the architectural or engineering company. These inspectors and testers track the construction process/progress and provide reports to the architect or engineer. Then the architect or engineer passes the report to the project manager or owner.

Prime Contractor

The prime contractor or general contractor is the company directly responsible for the actual construction of the project. The prime contractor may choose to give the work to the subcontractors, however, most have construction crews of their own to perform the many jobs that are not covered in subcontracts. The prime contractor is responsible for coordinating the work of the subcontractors and for paying them for work completed. (Figure 1-2)

Subcontractor

The subcontractor performs either specialty work that the prime contractor can not do, or work that the prime contractor would rather have other companies perform. The subcontractor's employees are still required to comply with the site rules and operating procedures of the prime contractor, even though they are not direct employees.

Chain-of-Command

Each company involved in a construction project has their own chain-of-command. (Table 1-1) For the purpose of this documentation, we are concentrating on the prime contractor. Normally, their chain-of-command is as follows:

Project Manager

The contractor has one project manager responsible for all of the construction projects. This person is responsible for coordinating equipment, ordering materials, scheduling projects, and allocating company personnel for all the projects awarded to the contractor.

Project Superintendent

The project superintendent follows the directions of the project manager. He coordinates the efforts and activities of all the subcontractors on the project and directs the efforts of the prime contractor's employees. The project superintendent is also responsible for working with the project manager to coordinate material and equipment delivery.

General Foreman

The foreman is responsible for specific areas of the project and follows the directions of the project superintendent. He is responsible for coordinating activities of the labor foreman and all personnel associated with a specific job. For example, a general foreman can be responsible for all concrete forming and placement activities, including scheduling placement activities and monitoring the safety and production of the crews assigned to him/her.

Table 1-1
Chain-of-Command for the Prime Contractor

Contractor Personnel	Responsibilities
Project Manager	Coordinates equipment, orders materials, schedules projects, and allocates company personnel for all the contractor's projects.
Project Superintendent	Coordinates the efforts and activities of all subcontractors on the project, and directs the efforts of the prime contractor's employees.
General Foreman	Coordinates activities of the labor foreman and all personnel associated with a specific job.
Labor Foreman	Coordinates activities of the crew under direction of the general foreman/superintendent. Submits time sheets for personnel/ equipment, prepares weekly progress reports, documents meetings, schedules equipment and material needs.

Labor Foreman

There may also be a labor foreman who is responsible for a smaller crew (3 to 10 laborers). Foremen direct the efforts of the crew to accomplish the tasks assigned by the general foreman or superintendent. Other responsibilities of a labor foreman often include submitting weekly time sheets for personnel and equipment, preparing weekly progress reports, documenting weekly safety and production meetings, as well as scheduling for equipment and material needs.

Roles of the Employer and Employee

The employer (or contractor) and the employee (or laborer) have similar roles in construction work. These roles can be categorized by what the Associated General Contractors (AGC) call "Skill, Integrity, and Responsibility."

Skill

Skill is the technical knowledge and practical experience to execute projects in a professional, efficient, and safe manner. It is the ability to:

- Do the job correctly in a timely manner.
- Complete the work within the estimated project cost.
- Maintain a safe work area.
- Maintain tools and machines.
- Wear the appropriate safety equipment (e.g., hard hats, gloves, respirators).
- Initiate ideas for getting the job done.
- Follow directions.
- Plan and organize work.
- Contain costs.

- Interact effectively at all organizational levels.

- Anticipate and solve problems before they become a barrier to the project.

- Accept change (e.g., shifting priorities, project modifications, and technologically advanced materials and methods).

- Seek out opportunities for advancement and professional development.

Integrity

Integrity is the moral obligation to honor, in a fair and honest manner, every oral and written contract agreed upon with every laborer, client, architect, subcontractor, and material supplier.

Construction projects and profits are built on teamwork. A great feeling of satisfaction comes from the relationships a person makes, keeps, and nurtures with other workers. These relationships help individuals develop a sense of teamwork, so they can keep working towards the common goal of completing the project.

Responsibility

Responsibility is organization and financial resources to fulfill all commitments promptly and completely.

The **employer** is responsible for:

- Treating employees fairly.

- Providing and maintaining a safe workplace that consists of the necessary tools and machines.

- Providing supervision and instruction to ensure the health, safety, and welfare of the workers.

The **employee** is responsible for:

- Showing up on the job at the appropriate time each day.

- Working skillfully, safely, and productively.

- Demonstrating an active concern for quality.

- Fostering a "Can-Do" attitude that will help the laborer and the contractor profit from the project.

- Being punctual. (This is critical, so that the project can be completed within the designated timeframe.)

- Displaying a positive attitude throughout the project. A positive attitude is easily identified by others.

- Setting and successfully achieving personal goals.

A career in the construction industry is usually rewarding for workers. They receive great satisfaction when a construction site starts from a hole in the ground and then transforms into a building. Also, workers feel they have contributed in making history. (Construction Management Practice by S. Peter Volpe, New York: Wiley-Interscience, 1972)

Purpose of a Contractor Association

Membership in associations provide an individual firm with local and national information, such as legislation, labor, contracts, subcontracts, and relationships between owner, architect, engineer, and contractor. The Associated General Contractors (AGC) has 104 local chapters and national headquarters where general contractors can get support and information. The AGC services its 32,500 members by:

- Providing technical support and training information.
- Promoting fair and honorable dealings with construction project owners and with all segments of the construction industry.
- Promoting free and unrestricted access to all construction markets, so that qualified contractors can pursue work competitively.
- Promoting the use of the single contract method of construction. (It is the most efficient and economical system of awarding construction contracts.)
- Working towards developing good relationships between members and their employees to provide safe working conditions, and to promote safe working habits on the construction projects.
- Working towards stimulating new construction markets and to create new jobs.
- Providing profit building services, such as education and training, collective bargaining, legal assistance, insurance programs, and market/business development.
- Working towards keeping the construction industry from being overly regulated. (AGC National Headquarters, 1992)

CONSTRUCTION LABORER CRAFT

Construction laborers are heavily engaged in all forms of activities, such as construction, demolition, rehabilitation, and maintenance of:

- Residential and commercial properties
- Highways, bridges, tunnels, dams
- Sewage and water facilities
- Nuclear and conventional power plants
- Asbestos and lead abatement
- Hazardous waste and nuclear remediation

In general, laborers are the first craft on the project and the last craft off the project, because they have the necessary skills to begin and complete a project.

Major Job Tasks for Each Construction Industry

The following is a condensed listing of the major job tasks performed by laborers in each construction industry.

Building Construction Industry

Concrete cutting and coring
Concrete placement and finishing
Concrete pump hose set up/operation
Concrete reinforcement installation
Demolition
Elevation and alignment control
Equipment signalling operations
Fencing erection
Forklift operation
Form building
Landscaping operations
Mason tending
Oxyacetylene cutting and burning
Rigging operations
Sandblasting
Scaffold erection
Screed operator
Shotblasting
Site security
Small equipment operation
Soil compaction operations

Highway Construction Industry

Asphalt laborer/raker
Blaster's helper
Clearing operations
Equipment signalling operations
Explosive handler
Grade setter
Guard rail and fencing operations
Hydraulic drill operator
Landscaper
Pneumatic drill operator
Powder man
Rigging operations
Screed operator
Soil compaction operations
Storm drain pipe layer
Traffic control
Truck spotter

Utility Construction Industry

Equipment signalling operations
Hand excavation/backfill
Line and grade operations
Pipe layer (e.g., water, sewer, gas, pipe fusion, and other utilities)
Rigging operations
Shoring operations
Soil compaction operations
Utility testing (e.g., hydrostatic and pneumatic)

Environmental Industry

Abrasive blast cleaning/spraying
Asbestos removal from pipes, vents, girders, and ducts
Clearing right of way
Compaction operations
Confined space cleaning
Containment structures operation
Demolition of structures
Drilling
Drum identification and inventorying
Drum sampling and removal, draining, labeling, transferring, storage
Equipment decontamination
Erection of dikes and containment
Fence erection
Installation of erosion curtains
Installation of protective membranes
Lead paint removal
Locating and uncovering buried drums
Pipe laying in conjunction with leaching and draining operations
Revegetation/landscaping
Spreading of gravel for access roads
Sweeping, shoveling, vacuuming

Benefits of a Union Membership

How much is a union membership worth?

In a 1991 report, the United States Bureau of Labor Statistics (BLS) provided information that proved union membership is worth $122 more a week, than non-union affiliation. Construction union membership paid $246 more per week than working non-union (Figure 1-3).

This report did not include the additional value of benefits, which is about double for unionized workers. According to the government survey, the average weekly earnings in 1991 for full-time unionized wage and salary workers was $526, compared with $404 for non-union workers. Over the year, the average weekly union earnings rose $17, while the non-union workers pay increased $14.

On an annual basis, the benefits package for the union members had nearly 90 percent more benefits than what the non-union employers could provide.

BLS noted that 16.6 million American workers were union members in 1991. These workers were better off economically in just about every category in both the blue collar and the white collar industry.

Highlights from the report follow:

- Male union members averaged $95 more a week than the non-unionized male workers. (The union average increased $10 in 1991.)
- Female union members earned $119 more a week than non-unionized female workers.

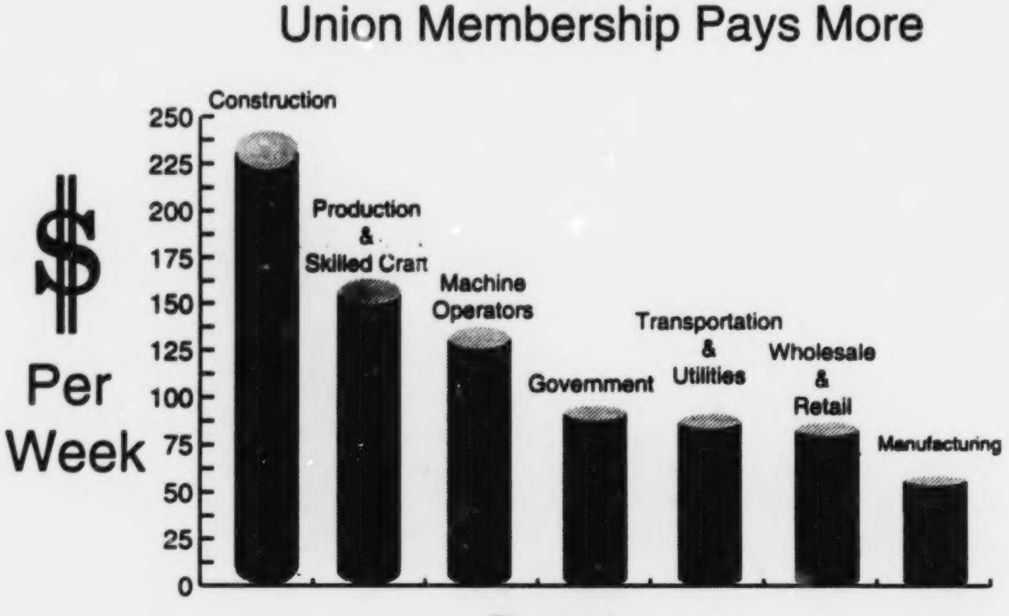

Figure 1-3
Union Membership

- African-American union members earned $147 more a week than non-unionized African-American workers.

- Hispanic union members earned $144 more a week than non-unionized Hispanic workers.

Union workers in many industries receive higher wages than non-union workers. Overall, unionized laborers and helpers earned an average of $177 a week more than workers who did not have a union contract.

The bottom line, especially in today's economy, is to have a good paying job with good benefits. Clearly, a union membership is one of the best investments workers can make for their future because the monetary return on a union card is 14 times the average cost of union dues. The BLS proves what we've known to be true for a very long time: It pays -- in many ways -- to be a union member.

Wages and Benefits

Each local union has its own locally negotiated wage and benefit package for laborers. For example:

We averaged eight 1992 construction agreements across North America and found that the average base rate for a laborer is $14.55 per hour. The lowest rate was $9.20 per hour and the highest rate was $18.91. (Remember, these are only sample rates and are subject to the locally negotiated agreement between the employers and local unions.) According to the Construction Labor Research Council in Washington, DC, laborers' wages will increase 3.4% in 1993. This means the average wage for the eight agreements would increase to $15.04 per hour.

Fringe benefit packages contain different types of benefits that are also locally negotiated. Most contain employer/employee contributions for health and welfare insurance, retirement, and training. Other plans are known to contain benefit packages, such as a vacation benefit, annuities, and legal service benefits.

Once negotiated, the amounts are forwarded by the employer to a fund administrator, who then disperses the benefits as needed.

The average benefit package is $3.18 per hour. With the lowest total package being $1.45 per hour and the highest $4.60 per hour. (Remember, these are only sample benefit packages and may not reflect the benefit structure in your area.)

How to Increase Wages

You can increase your wages by increasing your skill. It has been estimated, that trained laborers work almost 400 hours a year more than untrained laborers. Therefore, the more skills that you have, the more hours you will work in a year.

There is a skill classification for each job performed. (Refer to the section entitled Major Jobs Tasks for Each Construction Industry.) In most construction agreements, these classifications are separated into various wage groups. Each wage group reflects the increased pay associated with the increased amount of skill required for that classification. For example, in the highway construction sector, an asphalt raker classification pays more per hour than an asphalt worker classification. In the building sector, a tunnel laborer classification pays more per hour than a power and air tool operator classification.

The largest increase in pay will be realized when you advance to a supervisory position. For example, in some agreements, a labor foreman will be paid from $1.00 to $2.00 per hour more than the highest classification supervised. In addition to an increase in wage rate per hour, most foremen will receive additional time for preparation of progress and payroll reports. For example, a foreman may receive an additional $1.00 per hour, plus an extra hour, over the laborer who works the most hours on any particular day.

After you have proven to the contractor that you are a competent and reliable worker, your overtime may increase or you may be chosen to supervise the crew. Your wages will increase along with your job security.

Issues that Affect Wages and Benefits

Prevailing Wage Laws

In 1931, Congress enacted the Davis-Bacon Act that was signed into law by President Herbert Hoover. At the time the law was passed, Congress and the President were concerned about the bidding process on federal construction projects which was resulting in competitors underbidding each other by paying substandard wages. The bidding process was harmful to the workers and the fair contractors. The Davis-Bacon Act assures that workers on federally financed construction projects will be paid wage rates that prevail in their area of the country.

In the construction industry, work is funneled to contractors through a system of competitive bidding, that is, the lowest bidder will likely be awarded the project. Since labor is generally the only component of construction costs which a contractor can hope to exercise any significant degree of control, contractors have every incentive to slash wages in order to become the successful bidder.

Coupled with this basic characteristic of the competitive bid process are various economic attributes of the construction industry itself, which makes conditions extremely unstable for workers and contractors alike. For example:

- Employment is "casual" in the construction industry. (Workers move from contractor to contractor as one project is finished and another is beginning.)
- Employment varies from season to season. (Unemployed construction workers are persistently above the national average since construction work is often seasonal.)

With these pools of unemployed construction workers, unscrupulous contractors will not hesitate to lower wages in order to undercut the bids of fair contractors who truly desire to maintain adequate labor standards.

Local communities and taxpayers derive important protections from prevailing wage laws. The old adage "you get what you pay for," certainly holds true in the construction industry. Construction projects, particularly those in the public sector, such as dams, powerplants, highways and schools, require highly skilled labor. There is no doubt that wages of construction workers could be cut to the minimum by hiring unskilled workers. But would this really save the taxpayers money? The answer is no. First, unskilled workers take longer to do a job than skilled workers. Therefore, productivity would be down and the costs to the taxpayer would rise. Second, if the government wants quality construction projects, with fewer long-run maintenance costs, then it must attract skilled workers. And in order to attract qualified and well trained construction workers, it is necessary to pay no less than the local prevailing wage rate.

Right-To-Work States versus Collective Bargaining States

The National Association of Manufacturers began the first open shop campaign 88 years ago. Recently, "Right-to-Work" advocates have spoken glowingly of the benefits that flow from the open shop philosophy. Workers do not benefit from the Right-to-Work philsophy because contractors are allowed to pay workers wages below the industry average for their skills.

But the latest data comparing "Right-to-Work" states with free collective bargaining states reveal a continuing gap between the two groups in key economic and social indicators, such as wages, poverty, and workplace safety.

The following compares Right-to-Work states with Collecting Bargaining states:

- Workers in "Right-to-Work" states have lower per capita personal incomes. Workers in the free collective bargaining states earn $3,067 more per year.

- Residents in "Right-to-Work" states pay higher sales taxes. Sales Tax -- the most regressive of all taxes -- makes up 60.3% of "Right-to-Work" states' tax income, compared to 43.8% of free collective bargaining states' tax income.

- "Right-to-Work" states have higher job fatality rates. Only 14% of the "Right-to-Work" states have achieved job fatality rates at or below the national average, compared with 67% of the free collective bargaining states.

- "Right-to-Work" states spend less on education. Only 10% of the "Right-to-Work" states are at or above the national average of expenditures per pupil in public schools. 57% of the free collective bargaining states can make that boast.

Taft-Hartley Labor Act

In 1947, the Taft-Hartley Labor Act, sponsored by Senator Robert A. Taft and Representative Fred A. Hartley, was passed even though President Harry Truman had vetoed it. This Act has the following provisions:

- Declares that the union or the employer must notify the other party and a government mediation service before ending a collective bargaining agreement.

- Authorizes the government to obtain an 80-day injunction against any strike that endangered national health or safety.

- Prohibits jurisdictional strikes and secondary boycotts.

- Denies protection to workers on wildcat strikes.

- Outlaws the closed shop.

- Binds unions to file evidence with the U. S. Department of Labor that their union officers are not or were not communists. (Communists are not permitted to use the facilitities of the National Labor Relations Board.)

H.R. 5, The Workplace Fairness Bill

In a free society, a worker should be free to join a union and engage in concerted activity without being subjected to employer punishment or discrimination. Since 1935, workers have been assured by federal law, that they have the right to collective action and the right to strike.

Today, however, workers are being told, "You can't be fired for striking, but if you strike, you will be permanently replaced." Clearly, that's a contradiction in the law.

H.R. 5, the Workplace Fairness Bill, enacted by Congress in 1991, bans the use of permanent replacements during a lawful economic strike.

OSHA Reform Legislation

More than two decades ago, Congress enacted the Occupational Safety and Health Act (OSHA), that guarantees every American worker a safe and healthy work place. Since this act was passed, some progress has been made in improving working conditions, but for many workers, the right to a safe job is still a promise, not a reality.

The tragic fire that killed 25 workers behind locked doors at a poultry processing plant in Hamlet, North Carolina illustrates the shortcomings of OSHA. The plant was never inspected during its 11 years of operation, and workers did not receive any safety training.

Workers rarely complained for fear of losing their jobs. Unfortunately, these conditions are not unique. There are tragedies waiting to happen throughout the country.

The OSHA Reform legislation (S. 1622, H.R. 3160) is now being constructed by Congress. It will allow workers a voice in protecting their safety and health on the job, and it will make other important improvements in the law:

- Employers will have to establish safety and health programs to identify and correct hazards.

- Employers will have to establish joint safety and health committees for work places with 11 or more employees.

- Employers will have to provide workers with safety and health training before job assignments, and to retrain workers at least once every year.

- All workers, including federal, state, and local employees will be covered under the Act.

- OSHA jurisdiction could be given to another agency only when OSHA determines that the other agency's standards and enforcement are as effective as OSHA's.

- Workers will have the right to refuse unsafe work. They will also be protected against discrimination for complaining and reporting injuries, illnesses, and unsafe conditions.
- OSHA will have to issue final standards on key hazards by certain dates.

- OSHA will be required to update the exposure limits for toxic substances on a regular basis.

- Enforcement procedures will be strengthened to enable workers and their representatives to challenge weak citations and settlements. This will create stiffer criminal penalties for offending employers.

(AFL-CIO 1992 Leadership Manual -- Current Issues.)

LABORERS' INTERNATIONAL UNION OF NORTH AMERICA (LIUNA)

The Laborers' International Union of North America (LIUNA) is an organization with an active membership in excess of 500,000 laborers. LIUNA's membership includes a substantial number of minority and female members, as well as members from all ethnic backgrounds. The members are located throughout the United States and Canada and are organized into approximately 900 unions. LIUNA represents blue collar and white collar workers, such as:

- Concrete workers
- City and municipal employees
- Grounds crews
- Teachers
- Health care and nursing home employees

The preamble (beginning statement) of the LIUNA Constitution reads:

We, the members of the Laborers' International Union of North America, believing that Man is endowed with the inalienable natural right to provide for his existence and that of his family, and further believing that Man has the right to band with others who have a common or mutual interest in the protection of these natural rights, in a proper and lawful manner, do hereby adopt this as the Constitution of the Laborers' International Union of North America. (Source: LIUNA Constitution)

History

Reform movements like the Knights of Labor failed to organize laborers. But before the turn of the century, a number of local construction laborers' unions formed because of the exclusionary practices of craft unions. These newly formed locals provided a haven for laborers who weren't allowed to join building trade unions, or for laborers who needed a refuge from the appalling work conditions. At that time, poor working conditions were caused by unstable employers, fluctuating industry demands, and competition from the under-employed and unorganized.

The laborers' locals helped to stabilize a chaotic industry by giving employers a steady supply of experienced and productive workers. The locals also helped their members through collective bargaining and paid attention to their individual needs. They became a force in the family, community, and social life of their members. One of the locals' first acts in 1906 was to establish the Death Benefit Plan, so that members, despite their poverty, could be buried with dignity.

The district councils that were formed later produced another widening response to the laborers' needs. They came into existence when local unions, within a certain geographic area, felt they had to band together and hire a "walking delegate." These delegates policed work, protected jurisdictions, collected dues, and settled disputes.

Another development was the emergence of national, and international unions. Union locals needed to share information and experience and coordinate responses to employer organizations, such as the National Builders Association or the National Erectors Association. Unions were a powerful force around the turn of the century. (Working at the Calling, LIUNA, 1991)

LIUNA Benefit Funds

Laborers-Employers Cooperation and Education Trust (LECET)

In 1989, LIUNA established a labor-management partnership between LIUNA and signatory contractors, called the Laborers-Employers Cooperation and Education Trust (LECET). It is an educational fund financed through collective bargaining. LIUNA's mission is to generate business opportunities for union contractors and help its members to find safe and secure jobs. They also:

- Assist LIUNA members and contractors in supporting necessary safety legislation and enforcement.
- Establish the prevailing wage rate for the type of work performed on federally funded projects.
- Work with environmental clean up agencies to provide a qualified work force.
- Sponsor educational seminars to develop labor-management programs.
- Clarify new regulations and their impact.

Laborers' Health and Safety Fund of North America (LHSFNA)

In 1988, LIUNA established the Laborers' Health and Safety Fund of North America (LHSFNA) to:

- Improve the health status of construction laborers and their families.
- Improve safety and health conditions on the job.
- Assist in the control of the rising cost of health care insurance coverage.

Among its many activities, LHSFNA:

- Provides education and technical support in the fields of occupational safety and health.
- Conducts research into the causes of occupational injuries and illnesses.
- Develops intervention and prevention programs.
- Testifies before Congress and federal agencies on legislative and regulatory matters.
- Participates on committees, such as the Childhood Lead Poisoning Prevention Committee, and the Housing and Urban Development Advisory Group.

All initiatives are directed toward assisting LIUNA members and their employers, while improving the quality of life for the membership and their families.

Laborers-AGC Education and Training Fund

Laborers-AGC Education and Training Fund is a nonprofit, jointly administered labor-management trust fund. The parties to this fund are the:

- Laborers' International Union of North America (LIUNA)
- Associated General Contractors of America (AGC)

Laborers-AGC acts as an umbrella organization to provide primary support for over 70 funds engaged in construction and environmental training. They helped train LIUNA members for over 25 years.

History

Recognizing the inadequacy of on-the-job training, LIUNA began to formally train laborers with the assistance of federal funds from the Manpower Development and Training Act of 1962. The first training programs were designed to train laborers in 19 states. From this modest beginning, LIUNA expanded these pilot training programs throughout the country. These programs demonstrated to contractors and union officials that standardized quality training was essential. Training increased productivity and incorporated health and safety training as an integral ingredient for all courses. A problem inherent to all such subsidized efforts quickly became evident when government funding ended.

These pilot programs and the loss of federal funds brought about the following developments:

- Federal funds were replaced with a negotiated hourly contribution to support the continued effort.

- A Joint training venture between LIUNA and AGC to create Laborers-AGC.

Skills Training

From 1969 to 1978, the Laborers-AGC's main commitment was to skills training. The staff developed films, filmstrips, as well as student and instructor manuals to support basic skills training courses administered by local training funds.

These courses along with the materials developed by Laborers-AGC, comprise the core curriculum of the training funds now affiliated with the Laborers-AGC. The courses include:

Air Compressor
Air Tool Operation
Asphalt Raking
Blueprint Reading
Chain saw Operation
Concrete Placement
Concrete Sawing
Construction Surveying
Craft Orientation
Explosives/Blasting
First Aid/CPR
Foreman Preparedness
General Construction
Laser Operation
Mason Tending
OSHA Standards
Oxy-Acetylene Cutting
Pipe laying
Rigging and Signaling
Rock Drilling
Rough Terrain Forklift
Sandblasting
Scaffolding
Small Gas Engines
Soils Compaction
Traffic Control
Transit and Level
Trenching and Shoring

Several of these courses have become "industry standards," such as those involving trenching, shoring, and scaffold building. Audio-visuals developed for these courses have long been part of the OSHA inventory of training materials used by their compliance officials. OSHA training programs have used these audio-visuals, giving them credibility among contractors. Over the past 20 years, Laborers-AGC has invested nearly $12 million in the development, revision, and updating of these courses, as well as other related materials. Laborers-AGC has developed environmental programs that have received recognition as quality training courses. The environmental courses cover the following areas:

- Hazardous Waste
- Asbestos
- Lead
- Radiation
- Underground Storage Tanks

Courses are offered several times a year by a training fund. They may be as long as a six weeks or as short as one to three weeks. The six-week program is a comprehensive overview of all skills, while the one to three-week program focuses on specific skills. The local funds have very extensive training centers, and many of them are full service residential facilities. Each course involves classroom work and intensive hands-on training with a special emphasis placed on safety and health.

The classroom instruction can consist of:

- Hands-on training
- Videos and/or slide presentations
- Lectures
- Group discussions
- Introductory demonstrations for tool, equipment, and work procedures
- Field trips

Each training course may have 60-95% hands-on site specific training. This approach ensures proper and safe operation of the tools, equipment, and work procedures. The achieved goal is a training process that is planned, coordinated, and relevant to the work that the laborers would actually perform. Laborers-AGC incorporates information on industrial hygiene and other worker safety and health issues into the programs and materials that are provided to local funds for use in their basic skills training activities.

Beginning in 1986, Laborers-AGC returned to developing basic skills training curricula because of recommendations from an ad hoc committee representing a cross-section of local training funds. The previous process for program development was refined to include a Curriculum Review Committee comprised of expert representatives from local funds. The committees were used to aid in structuring the basic skills courses, and as a peer review process for the course materials as they were developed and refined by Laborers-AGC staff.

Late in 1989, other specific construction skill areas, such as Asphalt Raking, Concrete Placement, Mason Tending, and Pipe laying were included in this program. The program also took on a new name, called the "Construction Skills Training Program" (CSTP). It offers training to all construction laborers, regardless of geographic location in the United States or Canada. To date, this program has sponsored training for over 1,160 laborers at 10 regional training sites.

Using the CSTP as a model program, Laborers-AGC received funding for $1 million from the U.S. Department of Education for a "Cooperative Demonstration Grant." This grant provides a model for local training funds to replicate regional training and to establish a complete career path for construction laborers. The career path includes the establishment of a school-to-work connection, competency certifications at increasing proficiency levels, and post-secondary accreditation of construction and environmental skills training.

Various Pension Funds

Local, district council, and international pensions were wisely negotiated with unionized contractors to support LIUNA members when they retired. These solid pension plans give members comfort in knowing they will retire with a dependable income.

Construction Laborer Craft Career Path

Although the training funds offer their members high quality training, most do not offer sequential training courses or a complete career path option. For this reason, Laborers-AGC developed a series of courses that are taken sequentially. These courses provide a logical series of development steps for new members, and

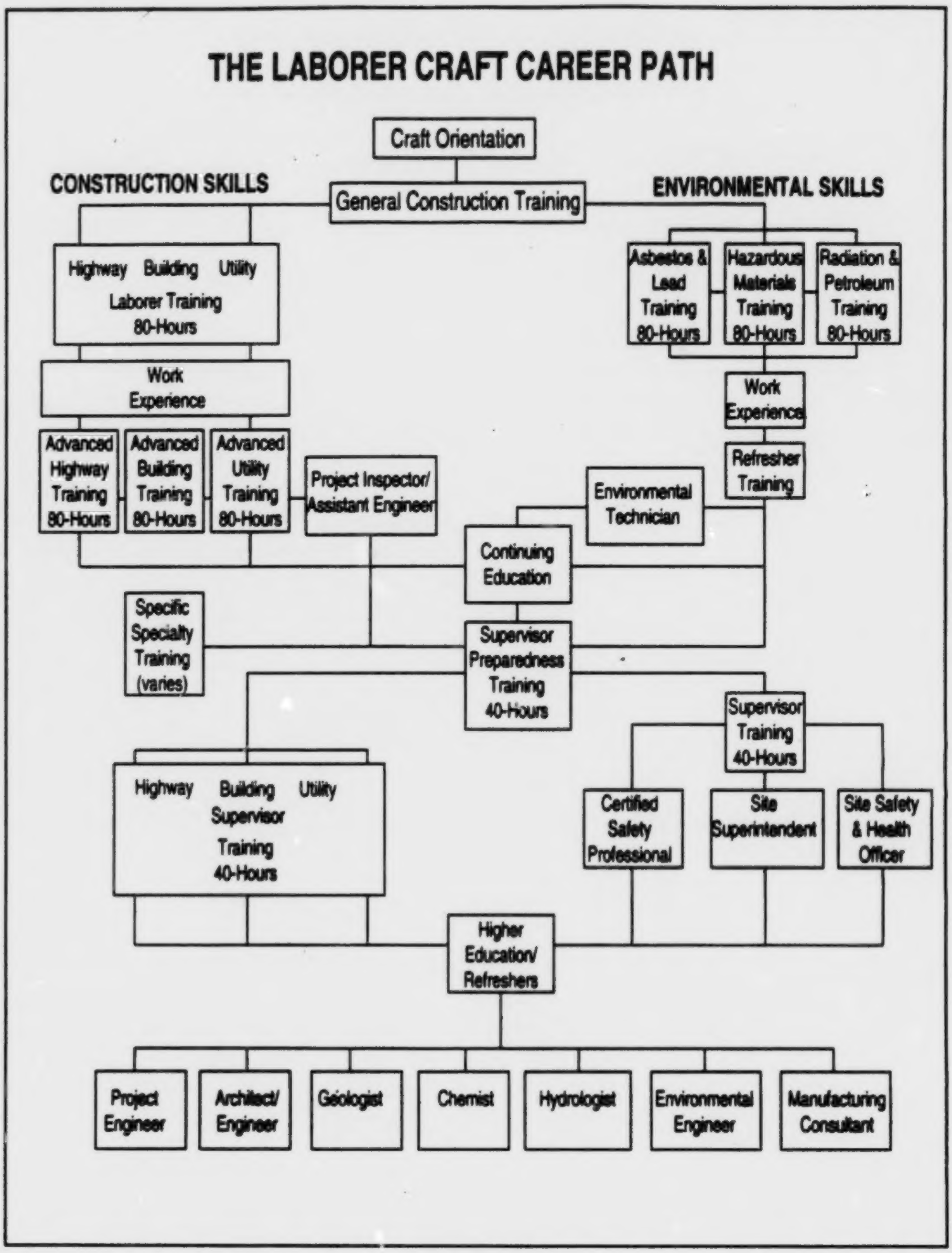
THE LABORER CRAFT CAREER PATH
Craft Orientation
CONSTRUCTION SKILLS
General Construction Training
ENVIRONMENTAL SKILLS
Highway Building Utility Laborer Training 80-Hours
Asbestos & Lead Training 80-Hours
Hazardous Materials Training 80-Hours
Radiation & Petroleum Training 80-Hours
Work Experience
Work Experience
Advanced Highway Training 80-Hours
Advanced Building Training 80-Hours
Advanced Utility Training 80-Hours
Project Inspector/ Assistant Engineer
Refresher Training
Environmental Technician
Continuing Education
Specific Specialty Training (varies)
Supervisor Preparedness Training 40-Hours
Supervisor Training 40-Hours
Highway Building Utility Supervisor Training 40-Hours
Certified Safety Professional
Site Superintendent
Site Safety & Health Officer
Higher Education/ Refreshers
Project Engineer
Architect/ Engineer
Geologist
Chemist
Hydrologist
Environmental Engineer
Manufacturing Consultant

Figure 1-4
The Career Path

upon completion, a member becomes a knowledgeable and skillful laborer.

Under the Department of Education grant, Laborers-AGC developed the "Construction Laborer Craft Career Path" program. It is a formalized, progressive, and sequential professional development plan.

The Career Path in Figure 1-4 outlines the entire range of required knowledge and skills from pre-job (Level I), to specialized (Level II), to advanced (Level III). The following describes each program plan level:

General Construction Skills
(Level I)

This 80-hour program is the first level offered. It serves as a prerequisite to other construction craft training courses. There is an introductory overview presented for each of the following topics:

- Material recognition
- Compaction techniques
- Cutting and burning
- Hand, air, and power tools
- Small gas engines
- Introductory construction math
- First aid, CPR
- Traffic control
- Knots and rigging
- Hand signals
- Hazard communication
- Safety and health issues

Construction Craft Skills/
Environmental Craft Skills
(Level II)

This program level offers trade-specific training through standardized and comprehensive courses in different skill areas, such as:

- Pipe laying for utility projects
- Grade checking for highway projects
- Concrete placement for building projects
- Asbestos and lead abatement
- Hazardous waste removal

One of the most dramatic efforts made by any union to enter a new marketplace is the Laborers-AGC training in environmental clean up. LIUNA carefully staked out its own territory in the rapidly growing clean up industry and is winning it over through training. The mainstay of their effort has been a five-year grant and supplement from the National Institute of Environmental Health Sciences (NIEHS). Laborers-AGC has trained over 10,000 workers under the NIEHS grant. The grant provides training to the laborers, at no cost, and to the training fund, at a minimal cost. In 1989, a site visit team from NIEHS rated the Hazardous Waste Worker Training Program as the best in the country.

Quality training has been a benefit to LIUNA since they are getting the biggest union share of hazardous waste work, which promises to be a trillion-dollar industry in twenty years. The 80-hour Hazardous Waste program is used to train personnel from other unions and government agencies. There is also a mobile training operation that can service any training site in the country. The bottom line is that union contractors are getting workers who are fully trained in all levels of hazardous waste removal. These workers are job-ready, legally certified, and trained in construction labor.

The oldest and most popular environmental program is the 32-hour Asbestos Abatement Worker course. Since its inception, in the fall of 1987, 150 instructors from 50 affiliated training funds were trained. This course certified over 30,000 laborers in removing and disposing asbestos safely. The EPA gave over $800,000 in grant support from 1989 to 1992 to help expand the course and initiate new training. Laborers-AGC is now trying to increase its outreach by setting up urban training centers in greater Los Angeles and greater Detroit for the special needs of cities dealing with asbestos.

Laborers-AGC's latest offering is a 32-hour course in Lead Abatement. It has been underway in at least seventeen training centers. Laborers-AGC anticipates that the Department of Housing and Urban Development will adopt training and worker certification requirements. In addition, Laborers-AGC anticipates that they will provide funding to support the training required for a clean up effort, that many predict will dwarf asbestos before it is completed. Laborers-AGC's work in lead abatement, along with the Health and Safety Fund, has again put LIUNA out in front in remediation techniques; this time in a field with few players.

A course in Nuclear Remediation initiates the laborer into a whole new area with the clean up of nuclear power plants. The "bomb factories" weapons facilities, such as Hanford and Savannah River, are one of the newest environmental scandals. Operated by the Departments of Energy and Defense, these places produced plutonium and other highly toxic materials whose by-products are just as dangerous. Improperly disposed of in many cases, these by-products are in the earth, ponds, and tanks, and in some cases, ground water. This clean up will cost billions of dollars. Fully trained and protected laborers will be needed on these jobs well into the 90s.

Supervision and Leadership (Level III)

This level III program provides an optional career path for those interested in increased job responsibility. It serves as a stepping-stone for jobs such as:

- Laborer Foreman
- General Foreman
- Site Superintendent
- Certified Safety Professional
- Site Safety and Health Officer

The 40-hour Foreman Preparedness Course, covers the following topics:

- Communication
- Dealing with people
- Job instruction training
- Construction math
- General project skills
- Problem solving

The laborer demonstrates proficiency at each level through competency or mastery tests. Laborers who are presently working can test into an appropriate level, so that the industry can recognize their achievements as they successfully complete the training. Competency certification enables the local union officials and the contractors to know their laborers' qualifications.

Laborers-AGC is working with the Department of Education to establish standards for awarding credit for training and work experience for an Associate of Arts Degree. Recommendations for college credit by the American Council on Education has recently been made for the following environmental courses:

- Hazardous Waste Worker (3 credits)
- Hazardous Operations (2 credits)
- Fermco (3 credits)
- Lead (2 credits)
- Radiation Worker (1credit)
- Asbestos Worker (2 credits)

Higher education serves as a stepping-stone for jobs, such as:

- Project Engineer
- Architect/Engineer
- Geologist
- Chemist
- Hydrologist
- Environmental Engineer
- Manufacturing Consultant

The Construction and Environmental Literacy program is a Laborers-AGC program that provides an incentive for laborers to develop themselves professionally.

Construction and environmental literacy has become a key issue for Laborers-AGC. They received a grant from the Department of Education to develop two new programs. One program is designed for non-English speaking laborers and the other one prepares laborers for environmental work. These new programs complement the existing "Learn at Home Literacy Program" which was used by over 1,200 members in its first year.

Comment From Arthur A. Coia, General President, LIUNA

"(LIUNA is) in the third successive year of membership growth. (This) is due to the recognition that union workers retain a big advantage in their paycheck and in fringe benefits. Union wages are about one-third higher than those paid to non-union workers. And union workers earn about 75 percent more in fringe benefits...Where there is union representation, unilateral changes in wages, hours, and working conditions are prohibited by law. Disputes with the employer are settled more objectively, because they are usually subject to resolution by an impartial arbitrator...

LIUNA and other unions are also reaping the benefits of their long commitment to education and training programs. Non-union workers are often discarded by employers when their immediate usefulness is completed...LIUNA, in conjunction, with our union contractors, has developed training, education, safety, health, and pension programs predicated on the long-run development of our members, contractors, and industries. Each year, we provide tens of thousands of our members with courses to upgrade their skills, enhance their productivity, and provide them with a long-term bond upon which they and their families can depend.

When workers, particularly the young, are given the chance to freely decide whether to join a union, they vote overwhelmingly in the affirmative. Election results in much of the public sector, and all across Canada reveal that workers in all walks of life overwhelmingly prefer union representation.

Workers throughout the world are clamoring for the freedom of association and a democratic voice in their affairs. We at LIUNA are proud to be part of an international movement to help workers gain greater control over their own destiny. We stand ready and willing to assist in their desire for union organization."

ASSIGNMENT SHEET

1. What does the term "construction laborer" mean?

2. What does a construction laborer do? (Please answer in one sentence.)

3. Why do you want to be a construction laborer?

SECTION II
MATERIAL RECOGNITION

Trainee Objectives

Trainees should be taught to:

1. Identify lumber by size and grade, including planed and rough cut boards, planks, and plywood.
2. Identify nails by size and type.
3. Identify concrete and masonry related materials.
4. Identify fuels and fluids, and appropriate containers.
5. Identify reinforcing bar and wire mesh sizes.
6. Read rebar tags to locate bundles of precut reinforcing delivered to the jobsite.

SECTION II
INSTRUCTOR OUTLINE

1. Take trainees to workshop for material identification. Use display boards for lumber, nails, and reinforcing. Include as many different sizes and types as possible.
2. Display and identify fuels and fluids such as gasoline, mixed gas, diesel fuel, oils, gear lube, transmission fluid, etc. Show acceptable containers and marking of containers to identify fuels.
3. Identify some concrete and masonry materials such as bags of portland cement, masonry cement, mason sand, and different sizes of aggregate.
4. Show trainees rebar tags, how to read them and how to locate bundles of rebar. Demonstrate methods of tying rebar.

SECTION III
HAND TOOLS

Trainee Objectives

Trainees should learn:

1. To correctly identify hand tools use on a construction site.

2. Uses of different hand tools

SECTION III
INSTRUCTOR OUTLINE

1. Display hand tools such as:

   a. Hammers - claw, ball peen, 4# and 8# to 12# sledge hammers
   b. Shovels - long and short handle, round and square point shovels and spades
   c. All types of bars for stripping, jointing pipe, wrecking, etc.
   d. Wheel barrows, Georgia buggies, and brick buggies
   e. Rag tapes, steel tapes, folding rules
   f. 4' - 2' levels and torpedo levels
   g. Concrete and masonry tools
   h. Miscellaneous tools such as: stake pullers, rubbing bricks, stringline, brooms, chalk box, wire brushes, pliers, wrenches, plumb bob, brushes, etc.

2. Explain safety methods and demonstrate use of each tool as necessary.

HAND TOOLS

Even though there are many different hand tools, you will find that some common problems occur. The tip of the tool may be chipped or broken. Handles may be cracked or splintered. Wrenches or sockets may be stripped. Impact tools like drift pins may have mushroomed ends and saw blades may be dull.

Screwdrivers

Screwdrivers were never made to pry, chisel, scrape or score, but they are misused for these purposes every day. The most common abuse happens when the screwdriver is not matched properly to fit the screw. If you see that the tip of the screwdriver has been rounded off, do not use it. Set it aside so that you can put it in a vise and redress or reshape the tip, later on. A file can be used to return the tip back to its' original shape. A grinding wheel on the bench grinder should not be used to reshape the tip because the temper is changed and the tool strength is weakened. You can also make the screwdriver safer and easier to use by wiping off any oil or grease on the handle. This only takes you a few seconds but it can make things so much easier.

Standard sized screwdrivers can come in lengths ranging from 2-1/2 to 12 inches. Electricians normally work with narrow bits with blade lengths that are no longer than 8 inches.

Pliers

Pliers fall into 3 groups; gripping, cutting and gripping and cutting. Never heat pliers. Heated pliers are ruined because the temper has been affected. Any set of pliers will last longer and they will be easier to use, when you put a drop of oil on the hinge once in awhile. Diagonal cutting pliers are called side cutters or side cutting pliers.

Linemen's Pliers

Linemen pliers are very popular on every construction site. These pliers come in two types; the New England style have a round nose and the Standard type that has a bevelled nose.

Ironworkers' Pliers

These pliers are used for tying rebar and for pulling, twisting and cutting wire during form work. The ironworkers' pliers look like linemen pliers except that the ironworkers' pliers have a distinctive hook on one of the handles.

Long Nose/Needle Nose Pliers

These pliers can reach into difficult places.

Diagonal Cutting Pliers

These pliers are mainly used to cut and skin wire or to remove cotter pins, nails or other fasteners.

End Cutting Pliers/Nippers

These pliers are used for soft wire, nails, rivets, or other small material, especially when the cut needs to be made close to the work. The dull cutting edges can be touched up with a small, medium sized honing stone.

Slip Joint Pliers

There are many uses for these pliers like gripping, turning, and bending.

Tongue And Groove/Channel Lock Pliers

These pliers will be mainly used by pipefitters, mechanics and electricians.

Vise Grips

Vise grips are not intended as a replacement for the proper size of wrench.

Wire Cutting/Stripping Tool

This tool is used to cut and strip small gauge wire.

Combination Square

The combination square is used to draw a line in work to ensure a straight cut is made on whatever material is cut.

Striking Tools

The diameter on the striking face of a hammer should be about 3/8 of an inch bigger than the diameter on the striking surface of the struck tool. Never use these tools when they have loose or damaged handles. Throw away any of these tools that have dents, cracks, chips, mushrooming, or excessive wear.

Hammers

There are many different hammers that are used in construction. You will find ball peen, soft hammers, claw hammers, and larger sledge hammers. It is important to check the hammer handle for any defects or looseness.

Replacing a hammer handle is fairly easy but it must be done properly. Once the handle is inserted into the head, the excess part of the handle must be sawed off. After that is done wedges must be driven into the top of the handle and then the extra bit of wedge is ground off.

Nail Hammers

Nail hammers are used only for driving or pulling common nails and for taking apart wooden structures. You will see curved claw, and straight or ripping claw nail hammers. Some hammers have a checkered face to reduce glancing blows and flying nails.

Ball Peen Hammers

Ball peen hammers are used for striking punches and chisels or for riveting, shaping or straightening unhardened metal. Remember that when you strike a struck tool, the diameter on the face of the hammer should be 3/8 of an inch larger than on the face of the struck tool.

Chipping Hammers

Chipping hammers are commonly found on construction sites where welding is taking place.

Bricklayer's Hammers

A bricklayers hammer has a flat face on one end and a sharp, hard cutting edge on the other end. It is used to set and cut bricks, tile and concrete blocks and to chip hardened mortar from bricks. Never issue a bricklayers hammer if it will be used to strike metal or striking tools.

Soft Face/Non-Metal Hammers

Soft face or non-metal hammers and mallets will prevent damage on the surface of the work. Wooden mallets are used for striking wood. Rubber, plastic and rawhide hammers are used for stone or brick setting. Soft face hammers may be made of other non-ferrous materials like copper, brass and lead. Some of the soft faces on these hammers can be replaced.

Bush Hammer

The bush hammer has sharp, hardened teeth on the striking face. These hammers are used for cutting and chipping concrete.

Punches

Punches are very good for removing pins and rivets. The starting punch and the pin punch are used together to drive out a part that is hard to remove. The aligning punch lines up the part and the centre punch is used mostly to make a small dent in material that has to be drilled. That way the drill bit does not wobble everywhere, creating a hazard. The centre punch will also put a mark into parts if the need arises. Punches should be replaced if they are mushrooming. The size of the punch can be found by measuring the width of on the of the punch.

Chisels

Cold chisels are used to cut any metal whose surface is softer than the cutting edge of the chisel. Cold chisel tips should be kept sharpened at a 60 degree angle. There are many types of wood working chisels. The size of chisel is determined by the width of the blade. Whenever you inspect chisels, look to see if they are damaged, by checking the ends for either mushrooming or broken tips.

Brick Chisel

These chisels are used by bricklayers to cut, mark, or trim brick or block. An appropriate sledge should be used to strike these chisels, not a bricklayers hammer.

Wood Chisels

Wood chisels are designed for rough cutting of wood.

Drift Pins

Drift pins are used for aligning holes in metal. There are two types of drift pins. The barrel type has tapered ends that are of equal length on both ends. The plug, taper, or standard type has a taper that is longer on one end.

Hammer-Type Flaring Tool

Flaring tools are meant to put a flare in water lines that range in diameter, from 3/8" through 2 inches. The tubing is usually copper and the flaring tool is struck by a hammer to form a flare, which helps to create a leak-proof seal in the water line.

Nail Puller Bar

Nail puller bars are designed to remove deeply driven nails. A small sledge hammer must used with these puller bars because the heel of the bar has to be driven into the nail. A nail hammer is used for driving nails, not nail puller bars.

Wrecking Bar

Wrecking bars are use to pry or lift heavy objects. They are also used to pull nails and spikes during demolition or form stripping.

Files

It is much safer to use a file that has an attached handle. If your hand slips while you are working with the file, the handle will protect you from gouging injuries. Never use the file tang (tip) to pry objects, because the file will break and cause an injury. Files come in different lengths and degrees of coarseness. The range of coarseness from roughest to smoothest includes the following:

- Rough
- Course
- Bastard
- Second Cut
- Dead Smooth

Files also come in different shapes:

- Round
- Half Round
- Flat
- Three Square (Rectangular)

When you are using a file, it will become plugged with shavings, especially if you are filing soft metals. The file will last longer and work better when you use a wire brush or file card to clean the teeth on the file. The file should be thrown away, only if you have made an attempt to clean it, and it still will not file properly. A smoother finishing cut can be made by rubbing chalk on the file.

Wrenches

The open end - box end or combination wrench is one of the most common wrenches in construction. All wrenches must be inspected on a continual basis, especially the ends, which may be stripped or cracked. Cracking and chipping ocurrs when cheaters (long pipes) are used to turn the wrench. Wrenches are not designed to take the extra stress exerted on them by a cheater pipe. There is always a proper wrench that is designed to do the job safely. You cannot assume that wrenches, or any other tools that have plastic or rubber handles are an insulated tool that will protect you from electricity. Some tools have high dielectric insulation that is meant only as a back-up in case of electric shock. This extra insulation is only a form of secondary protection in case of an accident. Tools that have this type of protection are clearly marked.

Adjustable Wrench / Pipe Wrench

Adjustable wrenches and pipe wrenches also play an important part in the construction industry. Adjustable wrenches come in lengths between 4 and 24 inches. Pipe wrenches come in lengths from 6 to 60 inches. If a short pipe wrench will not do the job, get a longer one, rather than using a cheater. Pipe wrenches are used to turn pipe or rigid conduit. The adjustable jaw on a pipe wrench can open from 3/4" to 8 inches. These pipe jaws are made of hardened steel and they last a long time. They can be replaced if they become worn out. Some pipe wrench handles are made of magnesium or aluminium alloy so that they are lighter and easier to use. Other specialized handles are made of non-sparking metals like beryllium copper or brass. These handles are especially made to be used in explosive environments.

Strap Wrenches

Strap wrenches can be used for any size pipe.

Torque Wrench

A torque wrenche is used when you have to tighten down a nut or bolt a specified amount. One special type of torque wrench is a torque multiplier. Take extra care if you ever use the torque multiplier since gears within the multiplier increase the initial force, 4 or more times. Torque wrenches are precision tools so handle them with great care. If a torque wrench is dropped, check the accuracy on a torque tester. Torque wrenches should be sent into the manufacturer periodically for repair, maintenance and calibration servicing.

Bung Wrench

The bung wrench is used to open a drum safely and efficiently.

Allen Keys

Allen keys or allen wrenches are used to turn special hex nuts or screws.

Socket Wrenches / Ratchets

The size of a ratchet is determined by its drive size. The most common drive sizes are 3/8, 1/2, and 3/4 inch. The drive size on the socket must match the drive size on the ratchet. Adaptors are available to increase or decrease the size of the drive on the ratchet. The number of points inside a socket varies from 6, 8, or 12 points.There are 3 types of sockets:

- Hand
- Power
- Impact

Thin walled hand sockets have a bright, shiny surface, but may be black, as well. Never use a hand socket on power impact wrenches. Hand sockets come in different variation types:

- Standard
- Flex (Universal)
- Deep Sockets

Impact sockets are flat black. Their heavy duty design helps them to withstand great torsion force. It is mandatory to use an o-ring and pin to attach the impact socket to the impact wrench.

Drive extensions allow workers to get at nuts and bolts that are hard to reach.

Nut Drivers

A nut driver is a screw-driver type tool that has a socket attached to the end of it. Nut drivers are found in smaller sizes up to 3/4 inch.

Saws

Hack Saws

Hack saw blades are marked to determine the blade length and courseness. You might see the following on a hack saw blade:

8 - 24

The first number represents the blade length. Hack saw blades are found in 8, 10 and 12 inch lengths. The second number represents the number of teeth per inch. Hack saw blades come in 14, 18, 24, or 32 teeth per inch. The blade becomes courser as the number becomes smaller. Some hack saw blades only have the courseness stamped on them. The finest hack saw blade (32) is used to cut conduit, thin tubing, and sheet metal. A blade with 24 teeth per inch can be used on angle iron, brass, copper, iron and pipe. High carbon steel is cut with the coursest blade. Whenever you select a hack saw blade, choose one that has a longer blade. You can take a longer stroke and cut material quicker with a longer blade. Install hack saw blades with the teeth pointing away from the blade so that the cutting can be made on the forward stroke.

Hole Saw

An arbor and drill bit attached to a hole saws will assist you in making larger diameter holes in different materials.

Common Saws

These saws have a number of teeth arrangements and degrees of courseness.

Tubing Cutter

A tubing cutter is used to cut small diameter tubing. A punch is needed to replace the cutting wheel.

Flaring Tool

A hammer type or a screw type of flaring tool can be used for to flare light metal or plastic tubing so that the tubing can be joined to a fitting. A flaring tool kit is used to flare tubular lines.

Tubing Benders

Tubing benders come in many different sizes

Snips

Hand snips are mostly used to cut sheet metal, but they can cut other things like steel strapping, gaskets or canvas. Snips are quickly ruined if they are used to cut wire. Occasionaly wipe the cutting edges with a lightly oiled rag and oil the pivot point. When you sharpen the blade edge, file from the outside to the inside. Keep locking snips locked when they are not in use. There are many different combinations of snips. Curved snips may be used to cut a tight radius, around curves or they may be used for cutting circles. There are two types of curved snips. The left cut snips cut curves to the left and the right cut snips cut curves to the right. These two snips will also make straight cuts. Straight cut snips are used to cut straight lines or very slight curves.

Bolt Cutters

You will find centre cut (general purpose), centre cut (high tensile), clipper cut and end cut bolt cutters. The jaws and heads on these bolt cutters can be replaced. Bolt cutters should be cleaned of any oil or grease and the parts should be lubricated. Keep the nuts and bolts tight.

Pipe Cutters

Inspect the wheels and rollers on pipe cutters often. Check rollers for wear, and inspect cutting wheels for cracks, dullness, and worn edges. If a complete turn cannot be made on a pipe, install all four cutting blades, if possible. Any number of cutters can be replaced with rollers. Different cutting blades are used for different jobs. Use the proper blade for the job.

Reamers

A pipe reamer is used to smoothen out a rough pipe after the cut has been made. When reaming is being done by hand it is recommended that a spiral ratchet pipe reamer is used to make the job easier. Hand reaming should done with a spiral reamer. Never use a spiral reamer on a power drive because the spiral reamer is self feeding and it will dig into the turning pipe causing serious damage to you or the pipe. A straight fluted is used with power drives. It can be used with a ratchet-type hand reamer, as well.

Vises

Vises are positioned on a bench so that the stationary jaw sticks out over the edge of the bench a slight amount. Long work pieces can be put into the vise without the bench getting in the way. Some examples of vises include the machinists, wood workers, pipe, and three legged vise. The machinists vise the most heavy duty of all the vises. Pipe vises can be found in yoke or chain type design.

Clamps

Store clamps by hanging them on racks. Clean and lightly oil all moving parts. The general purpose c-clamp is commonly used in construction. It comes in sizes ranging from 4 to 12 inches.

REVIEW QUIZ

GENERAL CONSTRUCTION - SECTION 1, 2 & 3

1. Name 4 major types of construction?

____

____

____

____

2. Construction Laborers are "all brawn and no brain." True or False?

   a. True

   b. False

3. How many jobs are predicted in new construction growth by the Bureau of Labor Statistics, in the next decade?

   a. none

   b. quarter million

   c. about one million

   d. about three million

   e. about ten million

4. What 6 year government initiative will provide $119.5 billion for highway and bridge construction?

   a. Environmental Protection Agency

   b. Intermodal Surface Transportation Efficiency Act of 1991

   c. Federal Highway Fund

   d. Superfund Amendments and Reauthorization Act

5. How many hazardous waste sites have been identified by the EPA?

   a. less than 1200

   b. more than 1200

   c. less than 120

   d. more than 120

6. Fill in the blank for the chain of command for a contractor:

   Project Manager

   ____

   General Foreman

   Labor Foreman

7. What are the 3 roles of the employer and employee in the construction industry? Fill in the blank.

   Skill

   Integrity

   ____

8. How much more per week does a union construction worker earn compared to their non-union counterparts?

   a. more than $122 per day
   c. more than $122 per month

   b. more than $122 per week
   d. more than $122 per year

9. Which statement is false?

   a. union benefits packages averaged nearly 90% less than benefits that non-union employers provided

   b. male union members averaged $95 a week more than their non-union counterparts

   c. union women earned $119 more than non-union women

   d. unionized African-American workers earned $147 a week more than in non-union

   e. unionized Hispanic workers surpassed their non-union counterparts by $144 per week

10. What was the average base wage for unionized laborers across North America in 1992?

   a. $9.20 per hour
   c. $18.91 per hour

   b. $14.55 per hour
   d. $20.91 per hour

11. How many more hours a year do trained workers work compared to untrained workers?

    a. 100 hours

    b. 200 hours

    c. 300 hours

    d. 400 hours

    e. same number of hours

12. What has been the end result of the Taft-Hartley Act?

    a. "right to work" states earn $3,067 less than in bargaining states

    b. sales tax in "right to work" states are 60.3% compared to 43.8% in the bargaining states

    c. only 14% of "right to work" states are at or below the national job fatality rate compared to 67% for bargaining states

    d. only 10% of "right to work" states spend as much or more than the education cost per pupil compared to 57% of bargaining states

    e. all of the above have been a result of the Taft-Hartley Act

13. Which statement is false as far as OSHA reform legislation is concerned?

    a. joint health and safety committees are not allowed in any situation

    b. employers are required to provide safety and health training

    c. workers have the right to refuse unsafe work

14. What is the active membership of the Laborers International Union of North America?

    a. about 150,000

    b. less than 250,000

    c. less than 500,000

    d. more than 500,000

15. What happened when Laborers-AGC first began training in the 1960's, using government subsidies, and the subsidies ran out?

    a. no more training took place

    b. the government never funded for training ever again

    c. negotiated hourly contributions were created along with the creation of Laborers-AGC

    d. the government asked for the money back

16. Which agency rated the Hazardous Waste Worker Training Program the best in the country?

    a. EPA

    b. LIUNA

    c. OSHA

    d. IRA

    e. NIEHS

17. How much larger in diameter does the striking face on a hammer have to be in comparison to a struck tool?

    a. 1/4 inch

    c. 1/2 inch

    b. 3/8 inch

    d. 5/8 inch

18. Name the 3 types of sockets?

    ____

    ____

    ____

19. When you see "10-32" written on a hacksaw blade, what does each number indicate?

    10 = ________________________________

    32 = ________________________________

20. Name 3 common ratchet drive sizes?

____

____

____

21. How could you tell the difference between a hand socket and an impact socket?

____

____

____

22. Name 4 different file shapes?

____

____

____

____

23. What is the purpose of a bung wrench?

____

SECTION IV
SAFETY

Trainee Objectives

Trainees should learn how to:

1. Work with the U.S. Federal OSHA regulations to include general safety regulations and specific regulations related to topics covered in this course.
2. Develop a construction safety attitude and awareness, specifically for the use of P.P.E.
3. Become aware of incorrect lifting procedures and learn the correct methods.
4. Become aware of the safety hazards associated with air tool operation.
5. Become aware of safety hazards associated with working at heights.
6. Become aware of safety hazards associated with excavations.
7. Become aware of safety hazards associated with working around equipment.
8. Become aware of safety hazards associated with cutting and burning operations.
9. Become aware of hazards associated with hazardous chemicals used on construction sites.

SECTION IV
INSTRUCTOR OUTLINE

1. Safety discussions should start by stressing the importance of safety awareness at the jobsite. Show video "An Awareness Program in Hazard Recognition" - Ontario Safety Clips.
2. Develop components for a safety awareness program. Ask trainees for input and establish the following list:
   a. Personal protective equipment (P.P.E). Make a list of P.P.E. Show video "The Choice is Yours" - AGC.
   b. Visual aids, such as posters, for constant reminders (posters should be changed often so they won't be ignored)
   c. Tool box meetings with foremen, 5-10 minutes each day.
   d. Safety training for new employees.
   e. Safety meeting with superintendent whenever new job starts.

f. Report, repair, or tag faulty equipment.

g. Discussion of previous experience with accidents.

h. Good housekeeping procedures.

i. First Aid and CPR training.

j. Fire and emergency procedures.

k. Hazard Communication - chemical lists, MSDS's labels etc.

l. Work attitude - always work safely.

3. Discuss and demonstrate correct lifting procedures. Show video "TIPS AV14 - The Mechanics of Lifting, Prying, and Moving Objects."

4. Hand out OSHA 3032 booklet "Your Workplace Rights in Action" Discuss and highlight booklet with trainees.

5. Hand out OSHA 2022 booklet. Use CFR Part 1926 and describe the following regulations. Refer trainees to appropriate section in their booklet.

A. OSHA Regulations

1. General Regulations
   a. 1926.20 General Safety and Health Provisions
   b. 1926.21 Safety Training and Education
   c. 1926.25 Housekeeping
   d. 1926.50 Medical Services and First Aid
   e. 1926.51 Sanitation
   f. 1926.52 Occupational Noise Exposure
   g. 1926.55 Gases, Vapors, Fumes, Dusts, and Mists
   h. 1926.56 Illumination
   i. 1926.57 Ventilation

2. Specific Regulations
   a. 1926.100 - 1926.107 P.P.E.
   b. 1926.150 - 1926.155 Fire Protection and Prevention
   c. 1926.200 - 1926.203 Signs, Signals, and Barricades
   d. 1926.250 - 1926.252 Materials Handling
   e. 1926.300 - 1926.350 Tools-Hand and Power
   f. 1926.350 - 1926.353 Welding and Cutting
   g. 1926.404(b) Electrical-Branch Circuits
   1926.416 General Requirements
   1926.417 Lockout and Tagging of Circuits
   h. 1926.451(a) Scaffolding-General Requirements
   i. 1926.500(a)-(f) Guardrails, Handrails, and Covers
   j. 1926.650 - 1926.652 Excavations

k. **1926.1050 - 1926.1060 Stairways and Ladders**
l. **1926.59 Hazard Communication**

General Regulations

OSHA Part 1926 - OSHA 2202
- **1926.20 - pp. 1-8, pp. 40-41**
- **1926.21 - pp. 8-13**
- **1926.25 - p. 47**
- **1926.50 - p. 52**
- **1926.51 - pp. 29, 69, 71**

OSHA Part 1926 - OSHA 2202
- **1926.52 - p. 44**
- **1926.55 - p. 40**
- **1926.56 - p. 47**
- **1926.57 - p.**

Specific Regulations

OSHA Part 1926 - OSHA 2202	
1926.100 - 1926.107	pp. 43, 44, 34, 57, 58
1926.150 - 1926.155	pp. 35, 37, 51, 45
1926.200 - 1926.203	pp.
1926.250 - 1926.253	pp. 67, 73, 29
1926.300 - 1926.305	pp. 17, 20, 22, 41, 49, 54, 58-61, 74
1926.350 - 1926.353	pp. 23, 71
1926.404(b) - 1926.417-417	pp. 30, 32
1926.451(a)	pp. 61-65

a. Show Video "Working at Heights Safely.

1926.500 (a)-(f)	pp. 38, 56, 68, 70
1926.650-1926.652	p. 33

b. Show Video "Success at the Top"

1926.1050 - 1926.1060	p. 42

6. Present Laborers-AGC Hazard Communication Program.

FALL PROTECTION

All fall arrest equipment must be inspected on a continuous basis. The waist belt and full body harness must be removed from service and destroyed if any defects are found. This applies to lanyards and hardware, as well. If the fall arrest equipment has been involved in a fall, it must be taken out of service and never used again.

The entire waist belt should be bent by hand, a little at a time, to check for broken strands or frayed areas. Pay close attention to the stitching at this time. The part of the belt that comes into contact with the buckle should be inspected carefully since a lot of wear occurs in this area. Eyelets on the belt become loose, distorted, or broken. Rivets become discoloured, pitted, or cracked due to chemical corrosion. They could be loose or bent, causing failure under stress.

The tongue buckle cannot be distorted in any way and the roller should turn freely on the frame. The second type of buckle called the friction buckle should also be checked for distortion. The corner and centre bars must be straight and the sliding bar must be free of cracks, distortion, or sharp edges.

Lanyards and Hardware

Lanyards must never have worn, broken or cut fibres. Snaps should never have cracks, corrosion or pitted surfaces. Keeper springs should return to their normal position after they have been opened. Dee rings should pivot freely and show no cracks, breaks, distortion or rough edges. Thimbles should not have any sharp edges, distortion or cracks.

Cleaning Fall Protection Equipment

Brush off any surface dirt and sponge the equipment with a mild soap solution. Any greasy equipment can be soaked in a solution of one tablespoon of grease cutter to one gallon of water. The final cleaning step involves rinsing the equipment and hanging it to dry.

LABORERS-AGC

Education and Training Fund

Hazard Communication Program

Worker Manual

LABORERS' INTERNATIONAL UNION of North America

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

MANUAL
for the
LABORERS-AGC
HAZARD COMMUNICATION
PROGRAM

Developed by

Laborers-AGC

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INTRODUCTION

The Hazard Communication Training Program was developed as an aid and reference for Laborers' International Union of North America (LIUNA) members to help them understand the requirements of the OSHA Hazard Communication regulations. It is not intended to, nor does it replace the mandated information and training required of contractors employing LIUNA members under those OSHA regulations. Completion of this training program, however, will facilitate and simplify the information and training demands on contractors. It will also enhance the effectiveness of contractors' Hazard Communication Programs. Its intended aim is to end the adverse health effects of hazardous chemicals used in the work place through the sharing of information and worker training.

After completing this program, the participant will be able to better understand and use the hazard communication information a contractor provides.

When you receive the hazard communication information from an employer, review the information using this manual as a reference. This will help you understand the hazards you will face on the job, and how you can protect yourself from those hazards.

SECTION ONE

HAZARD COMMUNICATION REGULATIONS

TRAINEE OBJECTIVES

At the conclusion of the session, trainees will be able to:

1. Give the basic employer requirements under the hazard communication regulations.
2. List the items that must be in a written hazard communication program.
3. List the basic information that must be covered in the employer's training program for hazard communication.
4. List the information the employer must provide each employee.

SECTION ONE

HAZARD COMMUNICATION REGULATIONS

BACKGROUND AND PURPOSE OF PROGRAM

This Hazard Communication Training Program was developed by Laborers-AGC Education and Training Fund, the Western Pennsylvania Laborers' Education and Training Fund, the Master Builders Association of Western Pennsylvania, and the Constructors Association of Western Pennsylvania. It is a joint labor-management effort. Our purpose is to provide you with information to make your employment in construction safer and healthier. By helping you to recognize and protect yourself from exposure to hazardous chemicals, you will be more confident about working safely.

MAKING THE PROGRAM WORK

To be effective, the program requires cooperation of the members of your union and construction management. The contractor must provide you with specific information and training about hazardous chemicals in your work area. You must use the information and training to recognize the chemical hazards in your work area and take steps to prevent exposure to those hazards.

OSHA has implemented regulations for the construction industry called the Hazard Communication Standard. (See Appendix A of this manual.) The regulations specifically state, "The purpose of this section is to insure that the hazards of all chemicals produced or imported are evaluated and that information concerning their hazards is transmitted to employers and employees."

These regulations require that manufacturers of hazardous chemicals inform your employer about the hazards of those chemicals. Then your employer must inform you about the hazards if you use these chemicals or if you come into contact with them during your job.

SCOPE OF THE STANDARD

This standard applies to any chemical known to be present in the workplace where employees may be exposed during normal use. It also applies when exposure to chemicals may occur during a foreseeable emergency.

This standard does not apply to:

- hazardous waste
- tobacco or tobacco products
- wood or wood products
- articles (chairs, tables, etc.)
- food
- drugs
- cosmetics
- alcoholic beverages
- consumer products

HAZARD DETERMINATION

The hazard communication standard requires chemical manufacturers, importers, and employers to determine if the chemicals or substances they produce, import, or use in the workplace are hazardous. In most cases, hazard determinations are done by the manufacturer of the chemical before being used in the workplace. If a substance is hazardous, it will fall under the scope of this standard.

WRITTEN HAZARD COMMUNICATION PROGRAM

Under the standard, employers and/or contractors must develop, implement, and maintain a written Hazard Communication Program. This written program must be available at the workplace. An example of a contractor's written program is in Appendix B. A company's written program must:

- List the hazardous chemicals on the job site.
- Explain the method the contractor will use to inform you of hazards associated with non-routine tasks involving hazardous chemicals.
- Explain the labels and other forms of warning to be used by the contractor.
- Explain how you will be provided with Material Safety Data Sheets (MSDSs).
- Describe contractor training to teach you about hazardous chemicals.

Multiple Employer Sites

To assure that workers will not be exposed to chemical hazards from another contractor at the same site, the regulations require that all the employers on a multiple employer site provide information to each other so all employees can be protected. Along with the information listed above, the written Hazard Communication Program of a multiple employer site must also:

- Explain how one employer will provide the other employer(s) with a copy of the Material Safety Data Sheet, or to make it available at a central location in the work place, for each hazardous chemical the other employer's employees may be exposed to while working.
- Give the methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the normal work place operating conditions and in foreseeable emergencies.
- Explain the methods the employer will use to inform the other employer(s) of the labeling system used.

This written Hazard Communication Program must be made available upon request to employees, their representatives, and OSHA.

INFORMATION AND TRAINING

The regulations require your employer to provide specific information and training so:

- You are aware of the hazardous chemicals used on the job.
- You know how to recognize these hazardous chemicals on the job-site.
- You know how they might affect your safety and health.
- You know how to protect yourself from those chemicals.

Your employer's instructions must cover at least the following hazard communication information:

- Requirements of the OSHA Hazard Communication Standard.
- Operations in your work area where hazardous chemicals are present.
- Location and availability of the:
  - Written Hazard Communication Program.
  - List of hazardous chemicals.
  - MSDSs for all hazardous chemicals used on the site.

Your employer must provide, or assure that you have been provided, all the following:

- Methods and observations you can use to detect the presence or release of hazardous chemicals in your work area including labels, color, form (solid, liquid, gas), and odor of the material.
- The physical and health hazards you may be exposed to from the hazardous chemicals on the job.
- How you can protect yourself through work practices, protective equipment, and emergency procedures.
- Details of the Hazard Communication Program used by the contractor including labels, lists, MSDSs, and how you can get and use hazard information.

This training program covers much of the basic information needed to understand chemical hazards, their effects on you, information the MSDSs contain, and the regulations on hazardous chemicals. Your contractor should have a copy of this training program and should cover any specific additional information you need to know when you are hired and during specific safety meetings on the work site.

SECTION ONE

ASSIGNMENT SHEET 1

1. Give the basic employer requirement under the hazard communication regulations.

2. List the items that must be in a written Hazard Communication Program.

3. List the basic information that must be covered in the employer's training program for hazard communication.

4. List the information the employer must provide each employee.

NOTES

SECTION TWO

MATERIAL SAFETY DATA SHEETS (MSDSs)

TRAINEE OBJECTIVES

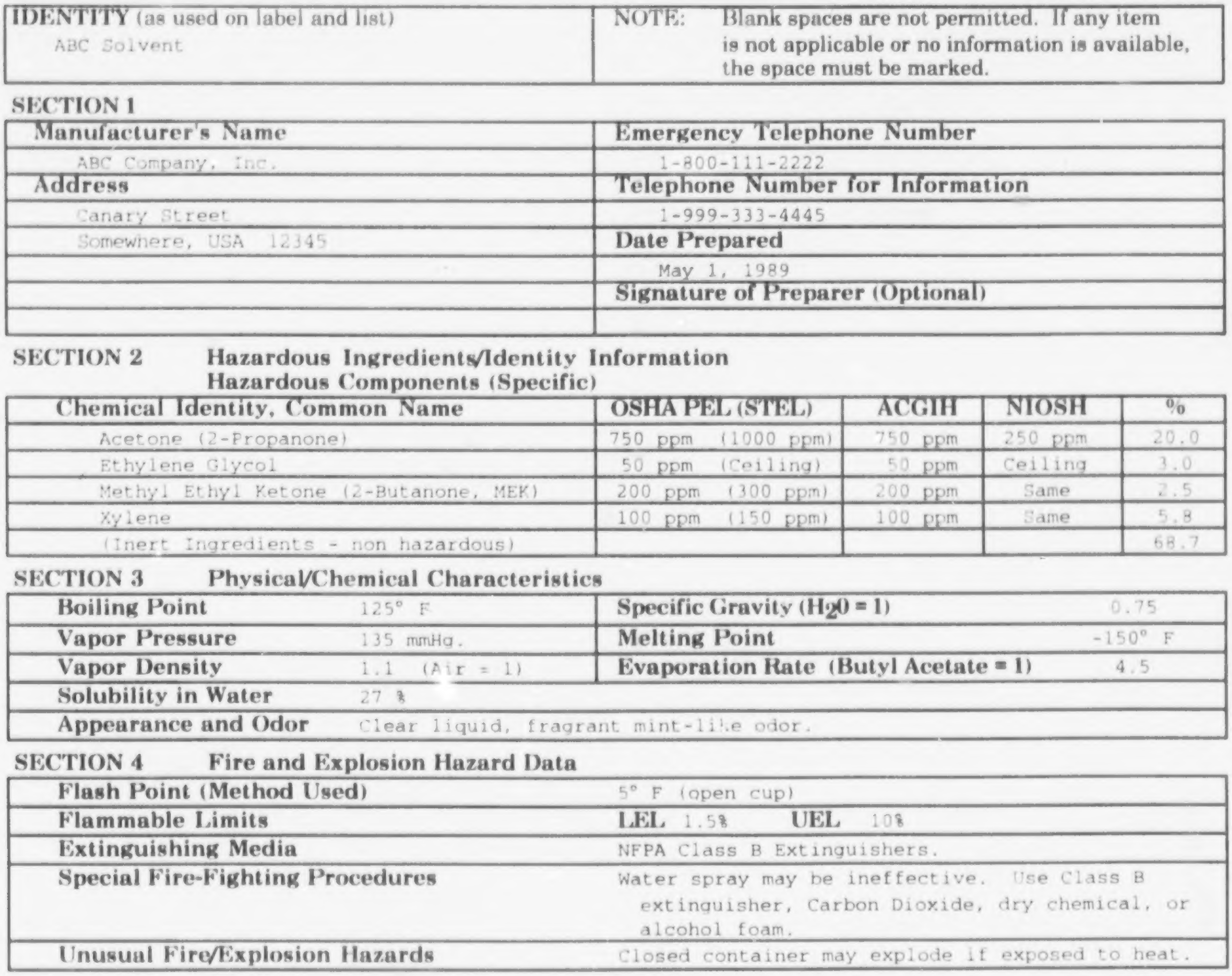
At the conclusion of the session, trainees will be able to:

1. Identify the individual sections of a MSDS and explain the general content of each.
2. List the forms chemical hazards may exhibit.
3. List three (3) typical physical hazards and give examples of each.
4. Explain the difference between flammable and combustible liquids.
5. Explain why some chemicals are considered reactive or corrosive.
6. Explain the difference between chronic health effects and acute health effects and give examples of each.
7. Explain the term "toxic".
8. List control measures that may reduce or eliminate health hazards.
9. Demonstrate how to use MSDSs by completing Assignment Sheet 3 using the sample MSDS given in Figure 1.

SECTION TWO

MATERIAL SAFETY DATA SHEETS (MSDS)

The Material Safety Data Sheet (MSDS) is the primary source of information about hazardous chemicals used on your work-site. A sample MSDS for a "make-believe" solvent is shown in Figure 1. Your employer is required to have a MSDS for every hazardous chemical used or stored on each job site. Your employer must make the MSDSs available to you or your union representative for review. The list and the labels are based upon the MSDS, so they are extremely important. MSDSs take many different formats but all must contain the following basic information.



IDENTITY (as used on label and list) ABC Solvent	NOTE: Blank spaces are not permitted. If any item is not applicable or no information is available, the space must be marked.

SECTION 1

Manufacturer's Name	**Emergency Telephone Number**
ABC Company, Inc.	1-800-111-2222
Address	**Telephone Number for Information**
Canary Street	1-999-333-4445
Somewhere, USA 12345	**Date Prepared**
	May 1, 1989
	Signature of Preparer (Optional)

SECTION 2 **Hazardous Ingredients/Identity Information**
Hazardous Components (Specific)

Chemical Identity, Common Name	OSHA PEL (STEL)	ACGIH	NIOSH	%
Acetone (2-Propanone)	750 ppm (1000 ppm)	750 ppm	250 ppm	20.0
Ethylene Glycol	50 ppm (Ceiling)	50 ppm	Ceiling	3.0
Methyl Ethyl Ketone (2-Butanone, MEK)	200 ppm (300 ppm)	200 ppm	Same	2.5
Xylene	100 ppm (150 ppm)	100 ppm	Same	5.8
(Inert Ingredients - non hazardous)				68.7

SECTION 3 **Physical/Chemical Characteristics**

Boiling Point	125° F	**Specific Gravity (H_2O = 1)**	0.75
Vapor Pressure	135 mmHg.	**Melting Point**	-150° F
Vapor Density	1.1 (Air = 1)	**Evaporation Rate (Butyl Acetate = 1)**	4.5
Solubility in Water	27 %		
Appearance and Odor	Clear liquid, fragrant mint-like odor.		

SECTION 4 **Fire and Explosion Hazard Data**

Flash Point (Method Used)	5° F (open cup)
Flammable Limits	**LEL** 1.5% **UEL** 10%
Extinguishing Media	NFPA Class B Extinguishers.
Special Fire-Fighting Procedures	Water spray may be ineffective. Use Class B extinguisher, Carbon Dioxide, dry chemical, or alcohol foam.
Unusual Fire/Explosion Hazards	Closed container may explode if exposed to heat.

Figure 1
Sample Material Safety Data Sheet (MSDS)

SECTION 5 **Reactivity Data**

Stationary	**Unstable** Explosive	**Stable**	**Conditions to Avoid** Heat, flame, electrical equipment.
Incompatibility (Materials to Avoid)			Unknown.
Hazardous Decomposition/Byproducts			Carbon Monoxide, Carbon Dioxide.
Hazardous Polymerization **May Occur** **Will Not Occur** X			**Conditions to Avoid**

SECTION 6 **Health and Hazard Data** ***HAZARD RATING : DANGER***

Routes of Entry	**Inhalation** X	**Skin** X	**Ingestion** X
Health Hazards (Acute and Chronic)	**ACUTE:** Eye, nose, throat, lung irritation. Central nervous system. Skin irritant. **CHRONIC:** No chronic effects reported.		
Target Organs	Eyes, Skin, CNS, and Respiratory System.		
Carcinogenicity:	**NTP** **IARC**	**Monographs**	**OSHA Regulated**
Not Reported			
Signs & Symptoms of Exposure	Eye, nose, throat, lung, skin irritation, headache, dizziness.		
Medical Conditions Aggravated by Exposure	Asthma		
Emergency & First Aid Procedures	Fumes: Remove to fresh air and notify a physician. Eye splash: Wash with running water for at least 15 min. Skin splash -- Wash with water.		

SECTION 7 **Precautions for Safe Handling and Use**

Procedures for Material Release or Spill	Remove all sources of ignition, avoid breathing vapors, ventilate (non-sparking equipment).
Waste Disposal Method	Dispose according to local/state/federal regulations.
Handling and Storage Precautions	Do not store over 110° F. Store as Class 1A NFPA flammable liquid.
Other Precautions	Group containers when pouring - WITH ADEQUATE VENTILATION

SECTION 8 **Control Measures**

Respiratory Protection (Specify Type)	NIOSH/MSHA approved positive pressure/pressure demand airline or SCBA.
Ventilation	
Local Exhaust	In use area.
Mechanical (General)	Area ventilation.
Special	Spills or confined areas.
Other	Use explosion proof electrical.
Protective Gloves	Butyl Gloves.
Eye Protection	Chemical Splash Goggles.
Other Protective Clothing or Equipment	Butyl splash apron when required to avoid splash exposure.
Work/Hygienic Practices	Do not eat, drink, or smoke in the area.

Figure 1 Continued
Sample Material Safety Data Sheet (MSDS)

BEST COPY AVAILABLE

MATERIAL SAFETY DATA SHEETS

A MSDS has eight basic parts:

Section 1	Identity and Manufacturer's Information
Section 2	Hazardous Ingredients
Section 3	Physical/Chemical Characteristics
Section 4	Fire and Explosion Hazard Data
Section 5	Reactivity Data
Section 6	Health Hazard Data
Section 7	Precautions for Safe Handling and Use
Section 8	Control Measures

These sections are explained in more detail in the following pages. Before each description, there will be a reprint of that section from the MSDS shown in Figure 1.

MSDS SECTION 1

IDENTITY (as used on label and list) ABC Solvent	NOTE: Blank spaces are not permitted. If any item is not applicable or no information is available, the space must be marked.

SECTION 1 Manufacturers Information

Manufacturer's Name	**Emergency Telephone Number**
ABC Company, Inc.	1-800-111-2222
Address	**Telephone Number for Information**
Canary Street	1-999-333-4445
Somewhere, USA 12345	**Date Prepared**
	May 1, 1989
	Signature of Preparer (Optional)

Identifies the chemical (as on label), the name and address of the manufacturer, phone numbers for use in emergencies or to get more information, and the date on which the MSDS was prepared. (Note: The date is particularly important in making sure the information contained in the MSDS is fully up-to-date as required by law.)

MSDS SECTION 2

SECTION 2 Hazardous Ingredients/Identity Information
Hazardous Components (Specific)

Chemical Identity, Common Name	OSHA PEL (STEL)	ACGIH	NIOSH	%
Acetone (2-Propanone)	750 ppm (1000 ppm)	750 ppm	250 ppm	20.0
Ethylene Glycol	50 ppm (Ceiling)	50 ppm	Ceiling	3.0
Methyl Ethyl Ketone (2-Butanone, MEK)	200 ppm (300 ppm)	200 ppm	Same	2.5
Xylene	100 ppm (150 ppm)	100 ppm	Same	5.8
(Inert Ingredients - non hazardous)				68.7

The second section of a MSDS identifies the hazardous ingredients and properties of the chemical. This includes the identity as well as the common name and trade name of the chemical, OSHA Permissible Exposure

Limits (PELs), established Threshold Limit Values (TLVs), and any other recommended limits.

To determine how hazardous a chemical is, you must first understand three things about the chemical:

- How toxic is the chemical?
- How long are you exposed to the chemical?
- How concentrated is the chemical?

In reality, all chemicals are potentially hazardous. From a toxic standpoint, chemicals may be only slightly dangerous, such as table salt, or highly dangerous, such as asbestos. The danger resulting from your exposure to a hazardous chemical is determined by two factors. One is how much of the chemical you are exposed to, and the second factor is the length of time you are exposed. This combination of "how much" and "how long" is called the **dose** of the chemical that your body receives. On construction sites, the extent of exposure varies from site to site, and day to day.

Several organizations have developed guidelines to help contractors control health hazards. These organizations publish suggested exposure limits. Exposure limits set the basis for safe working exposures. In most cases, exposure limits refer to concentrations of a toxic substance in the air over a normal 8 hour work shift (called an 8 hour time weighted average or TWA). They represent conditions under which nearly all workers are repeatedly exposed day after day without adverse acute or chronic health effects. The only exposure limit values enforced by OSHA are Permissible Exposure Limits or PELs and are based on TWAs.

Other hazardous chemicals may be dangerous to you and can cause adverse health effects if short period exposures exceed a certain level. Special exposure limits are set for these chemicals. They are called Ceiling Limits (C) and are levels of concentration or exposure that **can never** be exceeded. Immediately Dangerous to Life or Health (IDLH) values indicate an environment that is likely to cause death or serious health effects with very short exposures. These values are based on the best available information from industrial experience, experimental human studies, and animal studies. The basis on which the values are established may differ from chemical to chemical. Two organizations have published, required, or recommended safe working guidelines for exposures to hazardous chemicals:

- OSHA (Occupational Safety and Health Administration) sets PELs (Permissible Exposure Limits).
- ACGIH (American Conference of Governmental Industrial Hygienists) sets TLVs (Threshold Limit Values).

The product MSDS must list chemical exposure limits. The limits also may appear on the products container label. Exposure limits usually are given as "parts per million" (ppm) or milligrams per cubic meter (mg/m^3). One part per million is like a drop of chocolate in 14 gallons of milk. Many chemicals can affect your body in even smaller amounts.

Remember, different chemicals and substances pose different acute and chronic effects on your body at different levels of exposure. To protect your health, know the following information:

- The IDENTITY of the chemical.
- The LEVEL OF EXPOSURE, sometimes called the concentration.
- The EXPOSURE LIMIT (from OSHA, ACGIH and others).
- The proper safe working PROCEDURES and CONTROLS needed to keep your exposure below the exposure limit. For example; personal protection equipment such as respirators or gloves, and engineering controls such as ventilation devices.

MSDS SECTION 3

SECTION 3 Physical/Chemical Characteristics

Boiling Point	125° F	**Specific Gravity (H_20 = 1)**	0.75
Vapor Pressure	135 mmHg.	**Melting Point**	-150° F
Vapor Density	1.1 (Air = 1)	**Evaporation Rate (Butyl Acetate = 1)**	4.5
Solubility in Water	27 %		
Appearance and Odor	Clear liquid, fragrant mint-like odor.		

This section of a MSDS contains information on the physical and chemical characteristics of the substance, including the boiling point, vapor pressure and density, solubility in water, appearance and odor, evaporation rate, and melting point. These terms are defined in the glossary in Appendix C.

Forms of Hazards

Hazardous chemicals may be in various states. The state a chemical is in determines how you can be exposed and what parts of your body may be affected. The states or forms of chemicals are solids, liquids, or gases.

Solids

Solids may be large, such as a concrete block, presenting a physical hazard due to tripping, falling on you, or striking you. Very small particles, such as when cutting the same concrete block with a saw, presents a health hazard if you inhale these fine solid particles. Solids, therefore, can be very large or so small that you cannot see them without a microscope. Road dust, metal fumes from welding, dusts from pavement cutting, and pesticide powders are all examples of solids that can be health hazards.

Liquids

Liquids are materials that are fluid at normal temperature. All liquids are solids if they get cold enough and gases if they get hot enough. Liquids can be harmless or deadly. For example, water is harmless to you unless you try to breathe when you are under it. Other liquids, like acids, can burn, explode, or corrode your skin. Liquids (water, for example) can be in the form of a lake, a glass of water, a mist, or fog that can be inhaled into your lungs.

Gases

Gases are materials that completely mix with and behave like air at normal temperatures. Some gases may be lighter than air, such as helium, or heavier than air, such as hydrogen sulfide (sewer gas). Nearly all gases become liquids or solids if cold enough. A pure gas, such as helium, is 100% in the gas form at normal temperatures. Some gases, such as gasoline vapors, are in the liquid and gas form at normal temperature. The amount of gas or vapor given off by a liquid at normal temperatures depends upon the chemical and is called vapor pressure. Water, for example is 100% solid below 32° F, 100% gaseous above 212° F (at sea level), and a liquid between 32° and 212° F. The hotter a liquid, the more gas (or vapor) it is giving off until it boils and turns into all gas.

Because gases and vapors behave like air, they move quickly and present special hazards. A hazardous gas that is heavier than air can fill up a trench making it deadly. This gas would have a vapor density greater than one. Gasoline vapors can seek an ignition source a hundred feet or more before it ignites and races back to the liquid source.

MSDS SECTION 4

SECTION 4 Fire and Explosion Hazard Data

Flash Point (Method Used)	5° F (open cup)
Flammable Limits	**LEL** 1.5% **UEL** 10%
Extinguishing Media	NFPA Class B Extinguishers.
Special Fire-Fighting Procedures	Water spray may be ineffective. Use Class B extinguisher, Carbon Dioxide, dry chemical, or alcohol foam.
Unusual Fire/Explosion Hazards	Closed container may explode if exposed to heat.

Section 4 of a MSDS supplies fire and explosion hazard data, including the flash point of the substance, flammable limits, extinguishing media, and special fire fighting procedures.

Hazardous chemicals present two different types of hazards to workers depending on what chemical or material you are using. Some chemicals can be PHYSICAL HAZARDS. Others may be HEALTH HAZARDS.

Physical Hazards

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive. Physical hazards also include noise, radiation, heat and cold stress, back strains, and vibration or repetitive motion (ergonomics), and physical objects that could cause slips, trips, falls, or hit you.

Physical hazards may cause an injury due to a sudden release of energy such as a ruptured compressed air tank, or an explosion. These hazards cause immediate injury to you by an outside force.

Examples of physical hazards that can affect you on a construction site are:

Hazard	*Example*
Flammables	Gasoline
Combustibles	Fuel Oil
Compressed Gases	Nitrogen
Explosives	Powder Actuated Charges
Oxidizers	Oxygen
Reactive Materials	Acetylene
Acids	Sulfuric Acid
Bases	Sodium Hydroxide

Flammables

Solids, liquids, or gases that will ignite easily and burn rapidly are flammable. The National Fire Protection Association (NFPA) and the new United States Department of Transportation (US DOT) Regulations HM181 defines flammable liquids as a liquid having a flash point below 60.5° C or 141° F (water boils at 212° F) and or any material in a liquid that has a flash point at or above 37.8° C (100° F) that is intentionally heated and transported at or above its flashpoint in bulk packaging.

FLAMMABLE
3

User Precautions:

- Use with adequate ventilation.
- Ground and bond containers when pouring.
- Use only approved containers.
- Avoid all ignition sources (that is, heat, sparks, and fire).
- Keep containers tightly closed.
- Collect waste solvents for proper disposal. Avoid flushing down sink.
- Label container properly .
- Use CO_2, foam, or dry chemical fire extinguishers in case of fire.

MSDS SECTION 5

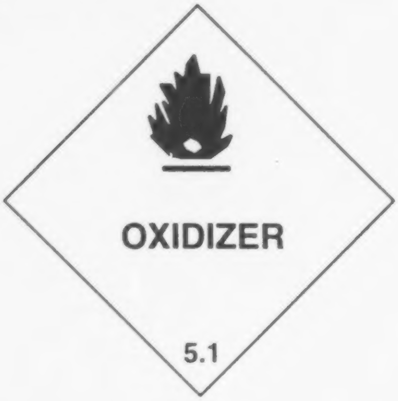
SECTION 5 Reactivity Data

Stationary	**Unstable** Explosive	**Stable**	**Conditions to Avoid** Heat, flame, electrical equipment.
Incompatibility (Materials to Avoid)			Unknown.
Hazardous Decomposition/Byproducts			Carbon Monoxide, Carbon Dioxide.
Hazardous Polymerization **May Occur** **Will Not Occur** X			**Conditions to Avoid**

Reactivity data in Section 5 means information on some of the conditions that can cause the substance to become dangerous. Information includes the stability of the substance and conditions to avoid, its incompatibility with other materials, and any hazardous decomposition properties or by-products associated with it. This section also supplies data on conditions that would cause this chemical to polymerize or break up and release hazardous chemicals into the work environment.

Reactive Chemicals

A chemical labeled "reactive" has a tendency to undergo chemical change and release energy. These chemical changes (and accompanying release of energy) may result in undesirable pressure build-up, temperature increase, or formation of noxious, toxic, or corrosive by-products. Chemical changes can be started by heating, improper storage or handling, or through direct contact with other incompatible chemicals.

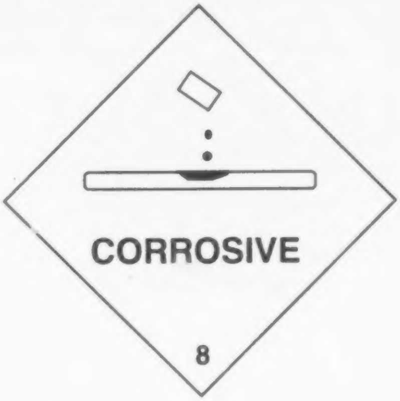


User Precautions:

- Handle chemicals with a "reactive" label by following instructions on the container label and on the Material Safety Data Sheet.
- Do not mix reactive chemicals with other chemicals unless specifically told to do so by the container label or your foreman. Do not mix reactive chemicals with water, as an undesirable chemical reaction may result.
- Do not heat reactive chemicals because violent reactions may result.
- Do not pour reactive chemicals into sewers or on the ground. Check the MSDS or ask your foreman for proper disposal methods.

Corrosive Chemicals

Corrosive materials contain acidic or basic substances that may burn, irritate, or destructively attack the body's tissues (skin, eyes, mucous membranes, lungs, or stomach). For example, battery acid (sulfuric acid) or Drain-O (sodium hydroxide) are corrosives.



User Precautions:

- Avoid contact with skin or eyes.
- Avoid inhalation of vapors.
- Use with adequate ventilation.

MSDS SECTION 6

SECTION 6 **Health and Hazard Data** ***HAZARD RATING : DANGER***

Routes of Entry	**Inhalation** X	**Skin** X	**Ingestion** X
Health Hazards (Acute and Chronic)	**ACUTE:** Eye, nose, throat, lung irritation. Central nervous system. Skin irritant. **CHRONIC:** No chronic effects reported.		
Target Organs	Eyes, Skin, CNS, and Respiratory System.		
Carcinogenicity:	**NTP** **IARC**	**Monographs**	**OSHA Regulated**
Not Reported			
Signs & Symptoms of Exposure	Eye, nose, throat, lung, skin irritation, headache, dizziness.		
Medical Conditions Aggravated by Exposure	Asthma		
Emergency & First Aid Procedures	Fumes: Remove to fresh air and notify a physician. Eye splash: Wash with running water for at least 15 min. Skin splash -- Wash with water.		

Health and hazard data in Section 6 describes the acute and chronic health hazards associated with the chemical. The data also identifies routes of entry into the body (whether through the skin, inhalation, or ingestion), target organs, carcinogenicity (cancer causing), signs and symptoms of exposure, medical conditions aggravated by exposure, emergency first aid procedures, and whether there is an OSHA regulation for the chemical. This section is very important to your safety.

Health Hazards

Health hazards on the construction site are not as easy to recognize as physical hazards. They may affect one or more of the many complex systems in your body.

"Health hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted according to established scientific principles, that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals that are cancer-causing or carcinogens; toxic or highly toxic agents; reproductive toxins; irritants; corrosives; sensitizers; kidney and liver toxins; toxins to the brain and nervous system; agents that act on the blood and blood producing system; and agents that damage the lungs, skin, eyes, or mucous membranes. Appendix A of the Standard provides further definitions and explanations of the scope of health hazards.

Hazardous chemicals pose a health hazard to you by upsetting the normal operations and function of your body. Depending on the chemical or substance, different internal or external body systems may be affected. For example, many solvents used in construction create health effects when they are inhaled. Once inhaled, they can reach the blood readily and affect different internal organs. In many cases the liver can remove the chemical from the blood stream, but in the process it may affect the liver's normal functioning, leading to other problems such as cancer.

Because the body is so intricate and complex, any disruption in its normal operation influences many other parts of the body. Therefore, we can see the importance of understanding the health hazards posed by toxic chemicals and knowing how to work with them properly. When working with hazardous chemicals you must know and understand potential hazards you are exposed to.

Some potential toxic or highly toxic chemical health hazards may be:

- Corrosives that burn skin on contact.
- Sensitizers that lead to rashes and reactions.
- Irritants to the skin, eyes, nose, throat.
- Damaging to internal organs (i.e., liver, kidneys, lungs).
- Damaging to the immune, circulatory, or reproductive systems.
- Cancer causing.
- Damaging to the lungs, skin, eyes, or mucous membranes.
- Irritating or damaging to the central nervous system.

Health Effects

Over exposure to hazardous chemicals can result in two (2) different effects. These are called acute or chronic health effects.

Acute Effects

Exposure to some hazardous chemicals may have an immediate effect on your body. They are called **acute effects**. An acute exposure to a chemical involves exposure over a short period, usually a few minutes. The reaction caused by the chemical may be as slight as a mild skin irritation or as serious as death. How your body reacts depends on how toxic the chemical is, how much of it you were exposed to, and how long your exposure lasted.

An example of an adverse health effect caused by a common acute exposure to a hazardous chemical is the irritation and reddening of the skin caused by sulfuric acid. Car batteries contain sulfuric acid. The acid may burn your skin, but the body can repair itself over time without any long-term health effect. More serious acute effects from other chemicals can kill you.

Chronic Effects

Exposures to certain other chemicals cause adverse health effects that develop much later, usually years later. They are called **chronic effects**. Chronic exposure to chemicals usually involves repeated exposure to a chemical over a long time. The adverse health effects from long-term exposure to hazardous chemicals are often the most difficult to recognize because often you are not aware that you are overexposed and because your body may not suffer any acute effects. The chronic effect depends on the chemical, the amount of the chemical, and the frequency of exposure. A chronic effect can be as slight as the dry, cracked skin of cement workers caused by calcium hydroxide, or it can be as serious as permanent tissue damage, such as asbestosis or cancer caused by repeated exposure to asbestos.

In summary, you must understand the difference between acute (short term) and chronic (long term) exposures to chemicals. Be alert to the acute (immediate) and chronic (delayed) effects chemicals can have on your health. It is not only important to understand how hazardous chemicals can affect you, you must know and be able to recognize your body's warning signs of over-exposure to hazardous chemicals.

Chemicals get into the body in four basic ways. The terms used to describe the four routes chemicals may take are: inhalation (breathing), absorption (through the skin), ingestion (swallowing), and puncture (such as stepping on nails, cuts, and needle sticks). Puncture is not a very common way for chemicals to get into the body. Do not handle chemicals with your hands, especially when you have cuts and open sores. Always wear the proper protective gloves when handling chemicals on the worksite.

"Inhalation" is the most common and important route of entry. It occurs when you breathe the material into the lungs. Chemical dusts (concrete dust for example) as well as chemical vapors (such as those from creosote) can cause irritation or injury to the nose, mouth, throat, or lungs when inhaled. Some chemical vapors, gases, or solid particulates (dust and fumes) can damage lungs when inhaled. Once in the lungs the chemical can enter your blood system. Your body's blood system then transports the chemical to internal organs. When the chemical reaches "target" organs such as the liver, kidney, or brain, they can be poisoned. Breathing certain highly toxic chemicals can stop your breathing.

Other hazardous chemicals that are inhaled may stay in your lungs and eventually plug up your lungs, resulting in decreased lung function. This condition limits your ability to work and can be disabling. An example is coal miners "black lung" disease where fine coal dusts, after years of exposure, just plug up the lungs. Asbestos fibers and silica dust are examples of materials used in construction that can have similar effects on your lungs. Asbestos fibers also can lead to a rare form of lung cancer.

Common sense tells you that if you can smell, or taste a chemical, or if your nose or throat seems irritated by a chemical, you're probably inhaling it. Unfortunately, not all chemicals are irritating or have a distinct smell or taste. As a result, not all chemicals warn you of their presence. Carbon monoxide, for example, is one gas produced by car exhaust that has no odor or taste. It is a silent killer.

"Absorption" is the entry of a chemical into your body through the skin. This is important because skin contact with chemicals frequently happens in the construction industry.

Your skin is normally an excellent barrier for keeping chemicals from entering your body. If your skin is cut or broken, your skin's protective oils or cell structure is damaged, or if the chemicals you are using aren't stopped by healthy skin, then even small amounts of chemicals can enter the body. Chemicals that enter your body this way usually do not harm your skin, so you might not even know you are being exposed.

When a chemical enters your body through your skin it can be carried to other internal organs by your blood.

Then these internal organs may be affected by the chemical making you ill. Certain pesticides, particularly in the concentrate form, can quickly penetrate your skin and make you extremely ill within a matter of minutes. Other chemicals may make you ill hours or days later.

"Ingestion," or swallowing, of toxic materials is the least common method for chemicals to enter the body on the job. Ingestion of chemicals seldom has adverse acute health effects except in construction situations where highly toxic substances such as lead, arsenic, or mercury are present.

Do not eat, drink, use tobacco products, or apply make-up in areas where chemicals are present. Eat meals in a separate clean area, but only after washing your hands and face. Be especially aware of the potential for ingesting chemicals if you snack throughout the day, or use tobacco products.

To recap, there are four routes chemicals can take to enter your body: inhalation (breathing), absorption (skin contact), ingestion (swallowing), and puncture.

So don't breathe chemical vapors, dusts, fumes, or mists. Keep chemicals off your skin. Wash your hands and face before eating, drinking, using tobacco products, or applying make-up if you have been working with chemicals. Always wash up before you leave the job at the end of the shift. Typical signs and symptoms of hazardous chemical exposures may involve:

- Eye, nose, throat irritation
- Odor
- Skin rashes and irritation
- Fatigue
- Breathing difficulties
- Headache
- Nausea or dizziness
- Irritability
- Coughing or sneezing
- Cold sweats
- Change in skin color
- Weakness

These signs and symptoms of chemical exposure are your body's way of reacting to foreign substances and to alert you that they may be causing harm.

Toxins

Toxic materials are those chemical substances that may cause chronic or acute damage to living tissue, impairment of the central nervous system, severe illness, or in extreme cases, death when ingested, inhaled, or absorbed through the skin. The body's toxic response depends on the nature of the substance, its concentration, and the length and type of exposure.

User Precautions:

- Use adequate ventilation.
- Avoid contact with skin and eyes.
- Avoid inhalation.
- Use appropriate personal protective equipment.
- Dispose of in an approved manner.
- Wash hands and face before eating, drinking, smoking, or applying make-up.

MSDS SECTION 7

SECTION 7 Precautions for Safe Handling and Use

Procedures for Material Release or Spill	Remove all sources of ignition, avoid breathing vapors, ventilate (non-sparking equipment).
Waste Disposal Method	Dispose according to local/state/federal regulations.
Handling and Storage Precautions	Do not store over 110° F. Store as Class 1A NFPA flammable liquid.
Other Precautions	Group containers when pouring - WITH ADEQUATE VENTILATION

This section deals with precautions for safe handling and use of the chemical. It includes steps to take in case the material is released or spilled, waste disposal methods, and precautions for storage.

Spill or Leak Procedures

Do not allow reactive chemicals to enter sewer systems where they may come into contact with water or metal. Besides the potential for fire or explosion, such disposal methods may violate state and Federal Environmental Protection Agency regulations. Check the MSDS for spill and leak containment and waste disposal procedures. Some procedures may include directions such as:

- Contain and neutralize material with appropriate spill kit.
- Flush with large amounts of water.
- Dispose concentrated corrosives as hazardous wastes.
- Ventilate area.
- Soak up with inert material.
- Wash area thoroughly.
- Keep all sources of ignition out of area.
- Collect spilled material and dispose of properly.

Storage

Pre-use handling, transportation, and storage of reactive chemicals require a great deal of care. For example, some reactive chemicals are heat sensitive and must be stored out of direct sunlight. Other reactive chemicals are sensitive to physical shock. Others exhibit increased shock sensitivity when temperature or pressure rises. In either case, an accidental bump or shock could start a violent reaction.

Many chemicals react violently when mixed with one another, for example, an acid (vinegar) and a caustic (baking soda). Reactive chemicals should be stored and transported separately from other chemicals. Some basic storage principals include:

- Store in an appropriate container.
- Keep containers tightly closed when not in use.
- Maintain only minimum quantities.
- Store away from ignition sources, preferably in a ventilated cabinet approved for flammable materials.
- Use approved containers if transferring material.
- Keep away from materials that may promote reactions (oxidizers).

SECTION 8

SECTION 8 Control Measures

Respiratory Protection (Specify Type)	NIOSH/MSHA approved positive pressure/pressure demand airline or SCBA.
Ventilation	
Local Exhaust	In use area.
Mechanical (General)	Area ventilation.
Special	Spills or confined areas.
Other	Use explosion proof electrical.
Protective Gloves	Butyl Gloves.
Eye Protection	Chemical Splash Goggles.
Other Protective Clothing or Equipment	Butyl splash apron when required to avoid splash exposure.
Work/Hygienic Practices	Do not eat, drink, or smoke in the area.

Section 8 covers control measures needed to protect employees from exposure to the chemical. These measures include engineering controls (ventilation, etc.); work practices; and personal protective equipment (respirators, gloves, etc.).

Worker exposure control measures fall into the following categories:

"Substitution" is the term used to get rid of a hazardous chemical by substituting another chemical that is non-hazardous or not as hazardous but still works effectively. This is the most desirable method of control.

"Engineering" controls reduce or eliminate exposures by using mechanical means such as ventilation systems, acoustical material, clean air control booths, and the like.

"Administrative" controls reduce exposures to an acceptable limit by removing the worker after a certain length of time. This method is used extensively by the nuclear industry to reduce radiation exposures.

"PPE" is the last resort used for reducing chemical exposures to a safe level. It is the method most used in construction. The term "PPE" is an abbreviation for Personal Protective Equipment. PPE includes respirators, gloves, protective suits, boots, and other gear that is worn to protect workers. No one type of PPE protects against all chemical exposure situations. As a result, there are many types of protective gear. Choosing the correct type requires an industrial hygienist or safety specialist that has a detailed knowledge of the site's specific chemical exposures. Workers should know types of PPE, their limitations, and how they are selected.

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SECTION TWO

MATERIAL SAFETY DATA SHEETS (MSDSs)

ASSIGNMENT SHEET 1

1. Identify the individual sections of a MSDS and explain the general content of each.

Section 1 ______________________________

Section 2 ______________________________

Section 3 ______________________________

Section 4 ______________________________

Section 5 ______________________________

Section 6 ______________________________

Section 7 ______________________________

Section 8 ______________________________

2. List the forms chemical hazards may exhibit.

3. List three (3) typical physical hazards and give examples of each.

1. ______________________________
2. ______________________________
3. ______________________________

SECTION TWO

MATERIAL SAFETY DATA SHEETS (MSDSs)

ASSIGNMENT SHEET 2

4. Explain the difference between flammable and combustible liquids.

5. Explain why some chemicals are considered reactive or corrosive.

6. Explain the difference between acute health effects and chronic health effects and give examples of each.

   Examples of acute health effects:

   Examples of chronic health effects:

7. Explain the term "toxic".

8. List control measures that may reduce or eliminate health hazards.

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SECTION TWO

MATERIAL SAFETY DATA SHEETS (MSDSs)

SMALL GROUP EXERCISES AND ASSIGNMENT SHEET 3

Goals of Small Group Exercises

The main goal for the small group exercises is to get everyone involved in the discussion of hazard communication issues. Any individual in a group may be asked questions about Material Safety Data Sheets. It is our hope that everyone discovers new information and reinforces and expands on the information learned during the lectures. Small group exercises work best when there is participation and interaction among all participants, so join in.

The Instructor(s) will introduce and briefly explain the workshop. Each group or table is responsible for finding the answers to the questions and recording them on their assignment sheets.

Reporting Session

The Instructor(s) will start a report-back session by asking for each group's or individual's answers. These small group exercises are designed to summarize the important topics covered in a MSDS. If you are not sure of an answer, or have any questions, please ask the Instructor(s). Remember it is the intent of the small group exercises to allow for the exchange and flow of information. Please be involved. The following objective is to be performed:

9. Demonstrate how to use MSDSs by completing Assignment Sheet 3 using the sample MSDS given in Figure 1.

   a. What is the name of the product? ______________________________

   b. List the hazardous components of this product. ________________
   ____

   c. Is this product lighter than air? Yes _____ No _____

   d. Is this product a solid? Yes _____ No _____

   e. What is the flashpoint of this product? _______________________

   f. Is this product flammable or combustible? _____________________

   g. Will this product explode? Yes _____ No _____

SECTION TWO

MATERIAL SAFETY DATA SHEETS (MSDSs)

SMALL GROUP EXERCISES AND ASSIGNMENT SHEET 3 Continued

9. Demonstrate how to use MSDSs by completing an Assignment Sheet using the sample MSDS given in Figure 1.

h. Does this product contain cancer causing components?
Yes _____ No _____

i. What are the routes of exposure? ______________________________

j. Is respiratory protection required while using this product?
Yes _____ No _____

k. What respirator should be used when using this product? __________
____
____

l. What other personal protective equipment is to be used with this product?
____
____

m. What conditions are to be avoided when using this product?
____
____

n. When was this MSDS completed? ______________________________

o. What is the emergency phone number for this product?
____

p. Is emergency and first aid information given?
Yes _____ No _____

NOTES

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SECTION THREE

CHEMICAL LABELS AND LISTS

TRAINEE OBJECTIVES

At the conclusion of the session, trainees will be able to:

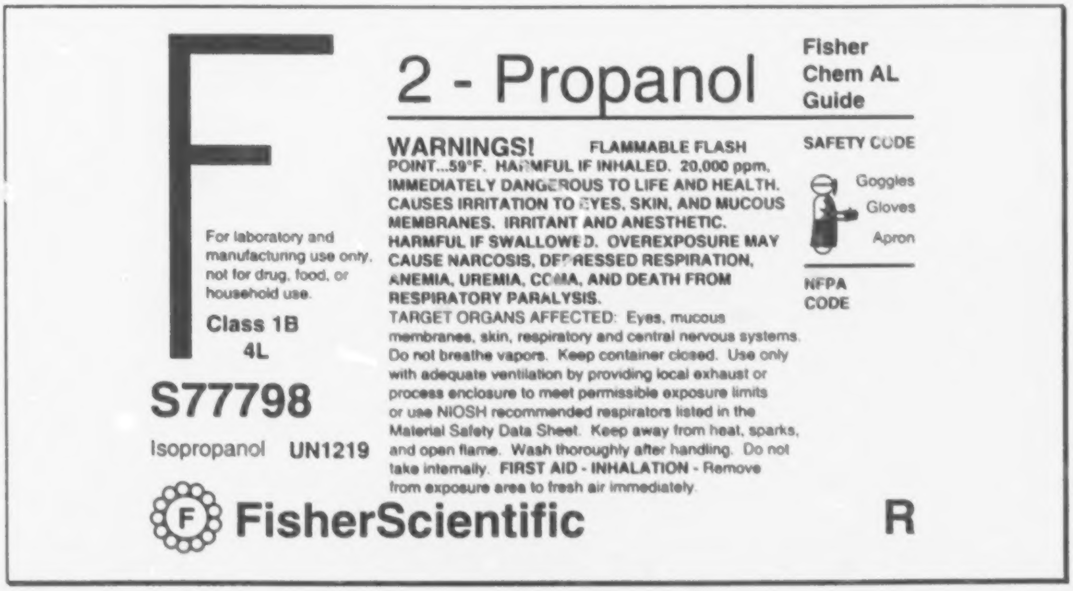
1. List the information that must be given on a typical label.
2. List the three basic types of labeling systems.
3. Demonstrate how to read a label by completing an Assignment Sheet using the sample label given in Figure 2.

SECTION THREE

CHEMICAL LABELS AND LISTS

Under OSHA regulations, all manufacturers, importers, and distributors of hazardous chemicals **must** label the product with information that permits you to determine the specific hazards of the product. Your employer may not remove these labels. In addition, if the contractor transfers the hazardous material into another container, he also must label the new container. Figures 2 and 3 show samples of labels that manufacturers or suppliers use on product containers. Labels must include:

- Name of the product.
- Name, address, and phone number of the manufacturer, importer, or supplier.
- Hazards of the product including information such as:
  - Precautionary warning words, such as "caution."
  - Physical hazards of the product, such as whether it will explode.
  - Reactivity hazards of the product, such as whether you can dilute it with water.
  - Health hazards of the product, such as whether it causes cancer.
  - Target body organs that might be affected by exposure, such as the eyes or lungs.
  - Measures to protect the user such as protective equipment or chemical resistant gloves.
  - Emergency first aid information, such as washing exposed areas with water for 15 minutes.



F

2 - Propanol

Fisher
Chem AL
Guide

WARNINGS! FLAMMABLE FLASH POINT...59°F. HARMFUL IF INHALED. 20,000 ppm, IMMEDIATELY DANGEROUS TO LIFE AND HEALTH. CAUSES IRRITATION TO EYES, SKIN, AND MUCOUS MEMBRANES. IRRITANT AND ANESTHETIC. HARMFUL IF SWALLOWED. OVEREXPOSURE MAY CAUSE NARCOSIS, DEPRESSED RESPIRATION, ANEMIA, UREMIA, COMA, AND DEATH FROM RESPIRATORY PARALYSIS.

TARGET ORGANS AFFECTED: Eyes, mucous membranes, skin, respiratory and central nervous systems. Do not breathe vapors. Keep container closed. Use only with adequate ventilation by providing local exhaust or process enclosure to meet permissible exposure limits or use NIOSH recommended respirators listed in the Material Safety Data Sheet. Keep away from heat, sparks, and open flame. Wash thoroughly after handling. Do not take internally. **FIRST AID - INHALATION** - Remove from exposure area to fresh air immediately.

SAFETY CODE

Goggles
Gloves
Apron

NFPA
CODE

For laboratory and manufacturing use only, not for drug, food, or household use.

Class 1B
4L

S77798

Isopropanol **UN1219**

FisherScientific

R

Figure 2
Partial Product Label

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Information might be presented on the container in the form of a sign, symbol, or written word. Important key warning words frequently used on labels include:

- **Caution:** Use with care. You are at some risk.
- **Warning:** The product presents more risk than one with a caution label.
- **Danger:** This is the most severe rating and shows a product presenting a serious potential threat to you.

ACETONITRILE
CAS NO. 75-05-08 NA-1648 RQ

WARNING!
FLAMMABLE
MAY BE HARMFUL OR FATAL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.
MAY BE IRRITATING TO THE SKIN, EYES, AND RESPIRATORY TRACT.
TOXIC EFFECTS MAY BE DELAYED.

Before using this product, read the MSDS which contains more detailed precautionary measures, handling instructions, and emergency procedures.

Keep away from heat, sparks, and flame. Avoid breathing vapor. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. If contact is unavoidable, wear protective clothing, face protection, and gloves. Wash thoroughly after handling and before eating, drinking, or smoking. Keep container closed.

FIRST AID:

If swallowed and victim is conscious:	Give 1-3 glasses of water or milk and INDUCE VOMITING. Do not induce vomiting with a semi-conscious or unconscious person. GET IMMEDIATE MEDICAL ATTENTION.
If in eyes:	Flush immediately with plenty of water for at least 15 minutes. Eyelid should be held away from the eye to ensure thorough rinsing. Get medical attention if irritation persists.
If on skin:	Wash exposed area thoroughly with soap and water. Remove contaminated clothing and shoes. Wash clothing and thoroughly clean shoes before reuse. GET MEDICAL ATTENTION.
If inhaled:	Remove affected person from the source of exposure. If not breathing, administer CPR. If breathing is difficult, ensure a clear airway and oxygen may be given. GET IMMEDIATE MEDICAL ATTENTION.

Standard Oil Chemical Company
Cleveland, Ohio, 44114-2375
U.S.A.

Figure 3
Product Label

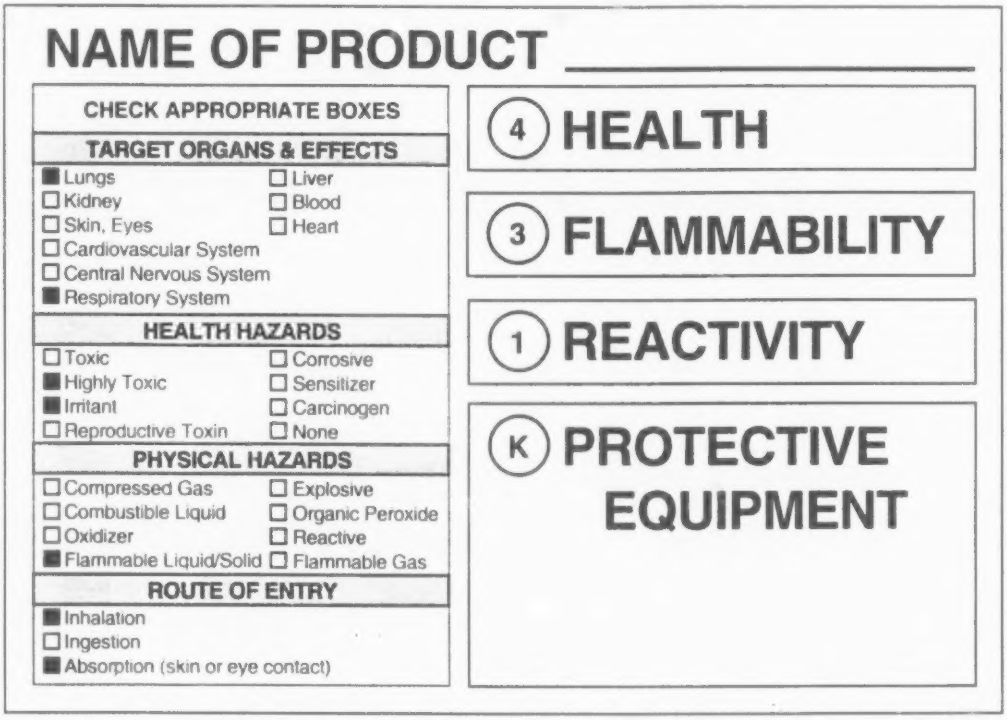
SPECIAL LABELS

Contractors may use special labels when hazardous chemicals are transferred from larger to smaller containers on the job site. These labels must not be removed or defaced because they provide you with important information. Figure 4 shows a typical label used for identifying hazardous materials in the Hazardous Materials Identification System (HMIS). The name of the product is listed and the appropriate boxes are marked under the headings:

- Route of Entry
- Health Hazards
- Target Organs and Effects
- Physical Hazards

The open circles in front of health, flammability, reactivity, and protective equipment, are filled in with a NUMBER or LETTER based upon the list found in Figure 5.

The information provided in the MSDS, the product LABEL, and DOT or NFPA labels often are used to fill out these special labels.



NAME OF PRODUCT ____________________

CHECK APPROPRIATE BOXES

TARGET ORGANS & EFFECTS

■ Lungs
☐ Kidney
☐ Skin, Eyes
☐ Cardiovascular System
☐ Central Nervous System
■ Respiratory System
☐ Liver
☐ Blood
☐ Heart

HEALTH HAZARDS

☐ Toxic
■ Highly Toxic
■ Irritant
☐ Reproductive Toxin
☐ Corrosive
☐ Sensitizer
☐ Carcinogen
☐ None

PHYSICAL HAZARDS

☐ Compressed Gas
☐ Combustible Liquid
☐ Oxidizer
■ Flammable Liquid/Solid
☐ Explosive
☐ Organic Peroxide
☐ Reactive
☐ Flammable Gas

ROUTE OF ENTRY

■ Inhalation
☐ Ingestion
■ Absorption (skin or eye contact)

④ **HEALTH**

③ **FLAMMABILITY**

① **REACTIVITY**

(K) **PROTECTIVE EQUIPMENT**

Figure 4
Typical Hazardous Materials Identification System Label

There are other labels that may be present on a container of hazardous chemicals that can provide information to you about the hazards of the chemical. These labels are in addition to the OSHA required labels. The two most common are NFPA and DOT labels.

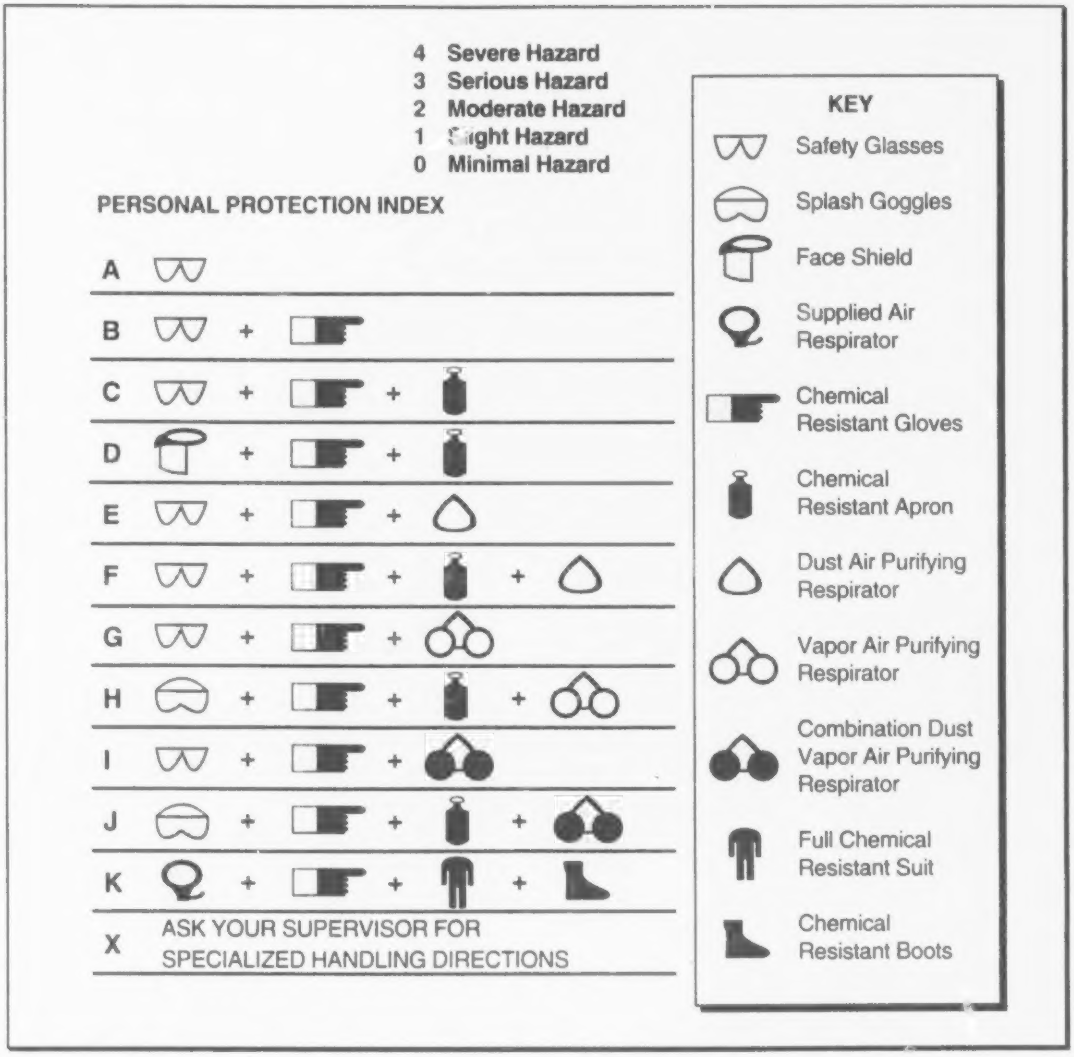

4 Severe Hazard
3 Serious Hazard
2 Moderate Hazard
1 Slight Hazard
0 Minimal Hazard
PERSONAL PROTECTION INDEX
A
B
C
D
E
F
G
H
I
J
K
X ASK YOUR SUPERVISOR FOR SPECIALIZED HANDLING DIRECTIONS
KEY
Safety Glasses
Splash Goggles
Face Shield
Supplied Air Respirator
Chemical Resistant Gloves
Chemical Resistant Apron
Dust Air Purifying Respirator
Vapor Air Purifying Respirator
Combination Dust Vapor Air Purifying Respirator
Full Chemical Resistant Suit
Chemical Resistant Boots

Figure 5
Hazardous Materials Identification System

NFPA

The NFPA label is a hazard system identification label developed to warn fire fighters about the potential hazards of chemicals in a fire situation. It is commonly used today and provides important information to you. The NFPA label is a diamond containing four squares of different colors. The internal squares are red, blue, yellow, and white. The red, blue, and yellow squares contain a number from 0 to 4. This is the hazard rating. Zero is no hazard, 4 is severe hazard, and 1, 2, and 3 are levels of increasing hazard below the 4 level. RED represents the fire hazard, BLUE the health hazard, and YELLOW the reactivity hazard. WHITE is reserved for special hazards such as "use no water" represented by W.

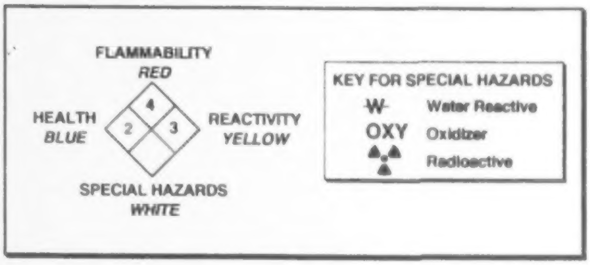


Figure 6
Sample NFPA Label Information

An NFPA label with the red square numbered 4, the blue square numbered 4, the yellow square numbered 0, and the white square blank, represents a chemical that is extremely flammable, is an extreme acute health hazard, is not reactive, and has no special hazards. The NFPA label does not cover chronic health effects. The names of the chemical, the product, and the manufacturer are not given. This information is required by OSHA regulations. Figure 7 shows the information provided by the NFPA Hazard Identification System.

	Health Hazard Color Code: **BLUE** Health hazards are noted in the blue quadrant and are rated from 0 to 4 with 4 as the most dangerous level Type of Possible Injury		*Flammability Hazard* Color Code: **RED** Fire hazards are noted in the red quadrant and are rated from 0 to 4 with 4 as the most dangerous level Susceptibility of Materials to Burn		*Reactivity Hazard* Color Code: **Yellow** Explosion hazards are noted in the yellow quadrant and are rated from 0 to 4 with 4 as the most dangerous level Susceptibility to Release of Energy
4	Extremely Hazardous (deadly) -- very short exposure can cause death or major long-term injury.	4	Extremely Flammable (below 73° F) -- turns into a gas rapidly under normal conditions and burns easily.	4	Extremely Unstable (may detonate) -- under normal conditions, this chemical may explode or react violently.
3	Highly Hazardous (extreme danger) -- short exposure can cause serious temporary or possible long-term injury.	3	Highly Flammable (below 100° F) -- liquid or solid can be ignited at almost any ordinary temperature.	3	Unstable (shock or heat may detonate or explode) -- may react with water, or may need heating or another strong initiating source.
2	Moderately Hazardous (hazardous) -- intense or continued exposure can cause temporary or possible long-term injury.	2	Moderately Combustible (between 100° F and 200° F) -- must be heated somewhat or be in a very hot place before ignition can occur.	2	Unstable (violent chemical changes) -- may react violently with water, or undergo violent chemical changes without exploding.
1	Slightly Hazardous (slightly hazardous) -- exposure can cause irritation but only minor injury	1	Slightly Combustible (above 200° F) -- must be heated before ignition can occur.	1	Unstable if Heated -- normally stable, but can become unstable when hot or under pressure. Reactions with water are not violent.
0	No Health Hazard (normal) -- exposure under fire conditions would offer no hazard beyond that of ordinary combustibles.	0	Nonflammable or Noncombustible -- will not burn.	0	Stable -- normally stable, even in a fire. Does not react with water.

Figure 7
NFPA Hazard Identification System

Department of Transportation (DOT)

The DOT label is used on containers and cartons of hazardous materials or products containing hazardous materials that are shipped across state lines. These labels are in addition to those required by the OSHA regulation. This label contains three types of information that you can use: color, hazard word, and hazard symbol.

The U.S. Department of Transportation issued a new final regulation (DOCKET HM-181) that became law on October 1, 1991. This regulation changes the classification categories of hazardous materials. It also changes packaging, package marking, labeling, and placarding requirements. There are several mandatory compliance dates, starting from October 1, 1991 through October 1, 1996. The most important date for you to remember is October 1, 1993. On this date, all new requirements for hazardous materials must be followed with the exception of placarding. New placarding requirements will not be enforced until the year 2001.

The color coded backgrounds and identifying words which represent the nature of the hazardous material are summarized below.

DOT Color & Word Identifiers

Color	*Word*
Orange	Explosive Blasting Agent
Red	Flammable Combustible
Green	Non Flammable
Yellow	Oxidizer Oxygen Organic Peroxide
White With Red Stripes	Flammable Solid
Yellow & White	Radioactive
White & Black	Corrosive
White	Poison Chlorine
Blue	Dangerous When Wet
Special	Biological Agent

The words used above are defined in the glossary in Appendix C. Figure 8 is an example of a hazardous word and symbol that may be used.

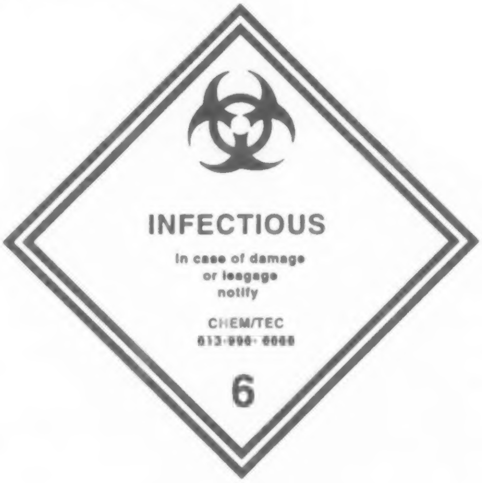
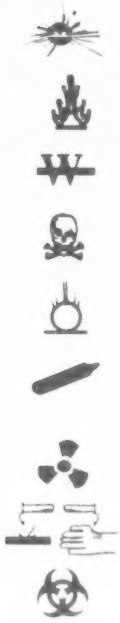


Figure 8
Example of Hazard Word and Symbol

Hazard symbols that may be used:



- Explosive
- Flammable
- Dangerous When Wet
- Poisonous
- Oxidizer
- Compressed Gas Non-Flammable Gas
- Radioactive
- Corrosive
- Biological Agent

The combination of COLOR, HAZARD WORD, and HAZARD SYMBOL gives you much information about the hazardous material. However, like the NFPA label, the DOT label does not tell you the name of the product or the manufacturer, or the chemical or chemicals it contains.

In addition to the new classification and labeling requirements that will become effective October 1, 1993, the severity of the hazard may be indicated on the shipping container through one of three packing groups. They are:

Packing Group I - Great Danger
Packing Group II - Medium Danger
Packing Group III - Minor Danger

Summary information on DOT labels is shown in Table 1. Table 2 shows the comparison of "old" DOT classifications versus the "new" or "present" classifications. Figure 9 gives examples of labels that may be found for each of the classifications.

TABLE 1
DOT SYSTEM
"OLD" CLASSIFICATIONS
GENERAL CHARACTERISTICS AND EXAMPLES OF HAZARDOUS MATERIALS

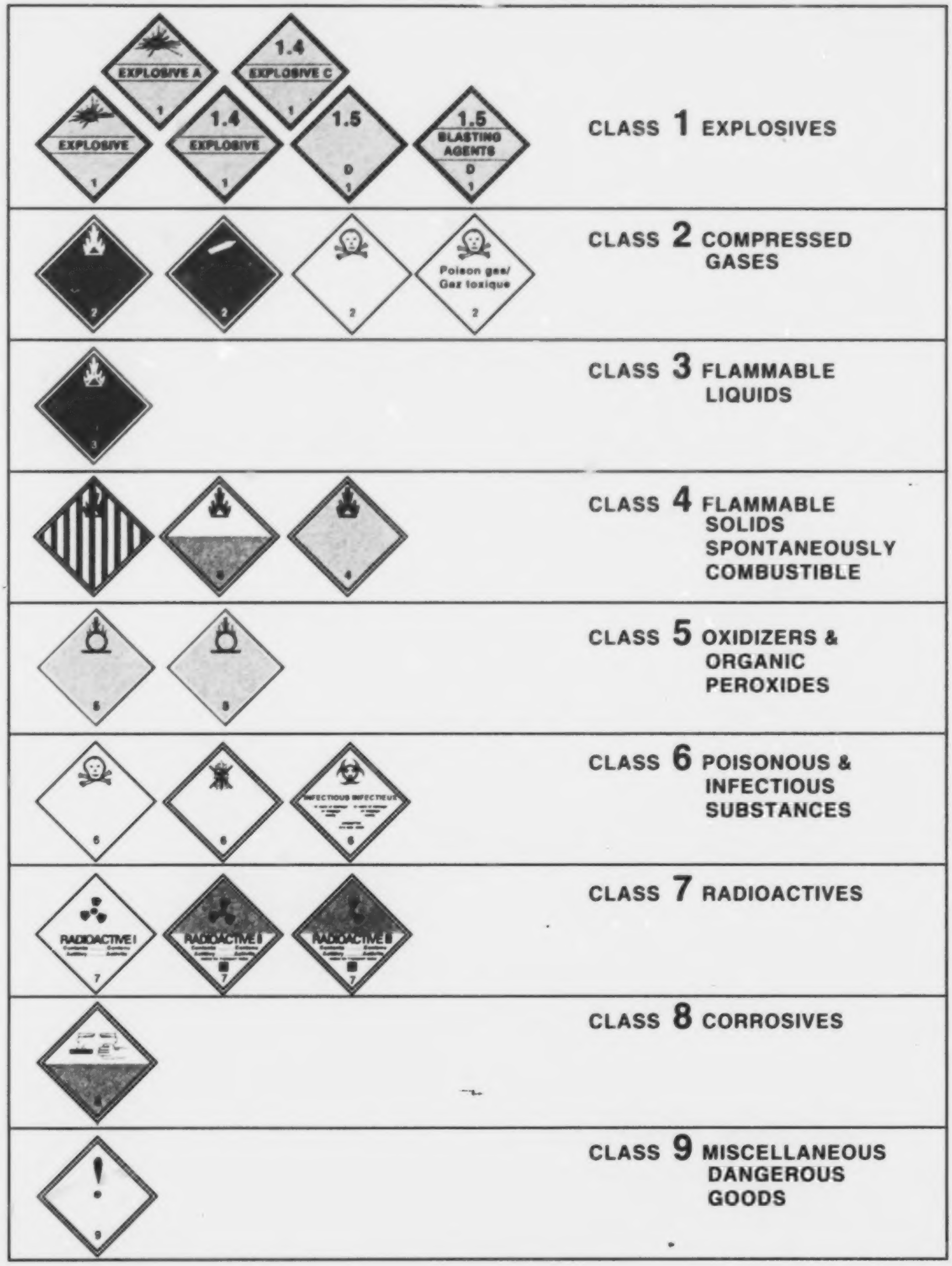
GENERAL CATEGORY DOT CLASSIFICATIONS	EXAMPLES	GENERAL HAZARDOUS PROPERTIES
Explosives and Blasting Agents		
Class A Explosive	Dynamite, Dry TNT, Black Powder	Sensitive to heat & shock
Class B Explosive	Propellant Explosives, Rocket Motors, Special Fireworks	Contamination could cause explosion
Class C Explosive	Common Fireworks, Small Arms Ammunition, Ammonium Nitrate - Fuel Oil Mixtures	Thermal and mechanical impact potential
Blasting Agent	Blasting Caps	Low sensitivity, possible ignition
Gases (Compressed, Liquefied, or Dissolved under Pressure)		
Flammable Gas	Liquefied Petroleum Gas, Acetylene, Hydrogen	Explosion potential, BLEVE, Vapor-air flam. hazard
Nonflammable Gas	Carbon Dioxide, Sulfur Dioxide, Anhydrous Ammonia	Compressed, some toxic
Nonflammable CL	Chlorine	Toxic
Nonflammable FL	Fluorine	Toxic, poison
Cryogenic	Ethylene, Nitrogen, Oxygen	Liquefied gases - cold temperatures - frostbite, high expansion ratio
Flammable and Combustible Liquids		
Flammable Liquid	Acetone, Gasoline, Methyl Alcohol	Flammability hazard (flashpoint less than 100°F)
Pyroforic Liquid	Aluminum Alkyls, Alkyl Boranes	Explosion potential
Combustible Liquid	Fuel Oils, Ethylene Glycols, Ink	Flash point 100° to 200° F potentially corrosive, toxic, thermally unstable
Flammable Solids		
Flammable Solid	Pyroxylin Plastics, Magnesium-Aluminum Powder, Charcoal	Readily ignites & burns explosively, some spontaneously
Water Reactive	Sodium & Potassium Metals, Calcium Carbide	Water reactive potential Toxic & corrosive potentials
Spontaneously Combustible	Phosphorus	Burns vigorously

TABLE 1 Continued
DOT SYSTEM
"OLD" CLASSIFICATIONS
GENERAL CHARACTERISTICS AND EXAMPLES OF HAZARDOUS MATERIALS

GENERAL CATEGORY DOT CLASSIFICATIONS	EXAMPLES	GENERAL HAZARDOUS PROPERTIES
Oxidizers and Organic Peroxides		
Oxidizer	Ammonium Nitrate Fertilizer, Hydrogen Peroxide Solution	Supply O_2 to support combustion of normally nonflammable material
Organic Peroxide	Benzoyl Peroxide, Peracetic Acid Solution	Explosively sensitive to heat, shock, friction Potentially toxic
Poisonous and Infectious Substances		
Poison A	Arsine, Hydrocyanic Acid, Phosgene	Harm from inhalation, ingestion, absorption
Poison B	Aniline, Arsenic, Methyl Bromide Tear Gas, Xylyl Bromide	Flammability potential
Etiologic Agent	Anthrax, Botulism, Rabies, Tetanus	Biological agents
Radioactive-Substances		
Radioactive Material	Plutonium, Cobalt, Uranium,	Particulate - alpha & beta particles
	Uranium Hexaflouride	Radiation - gamma rays (internal & external)
Corrosives		
Corrosive Material	Acids-Hydrochloric Acid, Oleum Sulfuric Acid	Disintegration of tissues fuming potential
	Bases-Caustic Soda, Caustic Potash	Oxidizing effect splatter potential
Other Regulated Materials (ORM)		
ORM A	Dry Ice, Carbon Tetrachloride	Toxic
ORM B	Quicklime, Metallic Mercury	Corrosive
ORM C	Oakum, Bleaching Powder	Unique hazards
ORM D	Consumer Commodity	Limited hazards
ORM E	Hazardous Substances - Pentachlorophenol, Adipic Acid, and Hazardous Wastes	Special hazards not otherwise covered

TABLE 2
DOT SYSTEM
COMPARISON OF "NEW" AND "OLD" CLASSIFICATIONS

Old Classes	New or Present Classes and Divisions
Explosives	*Class 1 - Explosives*
Explosive A	1.1
Explosive A or B	1.2
Explosive B	1.3
Explosive C	1.4
Blasting Agent	1.5
	1.6
Gases	*Class 2 - Gases*
Flammable Gas	2.1
Nonflammable Gas	2.2
Poison Gas	2.3
Flammable & Combustible Liquids	*Class 3 - Flammable liquids*
Flammable Liquid	3
Combustible Liquid	
Flammable Solids	*Class 4 - Flammable Solids*
Flammable Solid	4.1
Flammable Solid or Flammable Liquid (spontaneously combustible or pyroforic)	4.2
Flammable Solid, Dangerous When Wet	4.3
Oxidizing Substances	*Class 5 - Oxidizing Substances*
Oxidizer	5.1
Organic Peroxide	5.2
Poisons	*Class 6 - Poisons*
Poison B	6.1
Etiologic Agents (infectious substances)	6.2
Radioactive Material	*Class 7 - Radioactive Materials*
Corrosive Material	*Class 8 - Corrosive Materials*
Other Regulated Material (ORM)	*Class 9 - Miscellaneous HM*


EXPLOSIVE A
1
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EXPLOSIVE C
1
EXPLOSIVE
1
1.4
EXPLOSIVE
1
1.5
D
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BLASTING AGENTS
D
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CLASS 1 EXPLOSIVES
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2
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Poison gas/
Gaz toxique
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RADIOACTIVE I
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RADIOACTIVE II
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CLASS 7 RADIOACTIVES
CLASS 8 CORROSIVES
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CLASS 9 MISCELLANEOUS DANGEROUS GOODS

Figure 9
Examples of DOT Labels

HAZARDOUS CHEMICAL LISTS

Every employer who uses or stores hazardous chemicals on the job site **is required** to develop and make available a CHEMICAL INVENTORY LIST. This list identifies the chemicals used on the work site that are potentially hazardous and to which you may be exposed. The chemical or product name located on the employer's CHEMICAL INVENTORY LIST must be the same as the name on the container label and its corresponding MATERIAL SAFETY DATA SHEET. In this way, you can easily locate any additional information you may need to protect yourself.

This list may be posted at the job site available for your review. It will be updated as necessary, whenever any new chemicals or substances are brought to the site, or if chemicals are no longer used. A sample Chemical Inventory List is shown in Figure 10.

A.B.C. COMPANY, INC.
123 EASY STREET
ANYWHERE, USA 12345

CHEMICAL INVENTORY LIST

Acrylic Water Base Paint (Lambert)
Ater Blasting Shop Primer Red 53-R-101
Cosmiscoat Pavement Sealer
Deck Paint Blue Gray 58-F-23 (Mobile Chemical Co.)
Deck Paint Brown 58-D-95 (Mobile Chemical Co.)
Deck Paint Ocean Gray 58-F-14 (Mobile Chemical Co.)
Duracrylic Extra High Gloss Thinner (PPG Industries)
E Enton 37-127 Epoxy Resin (Reichold Chemical)
E Enton 37-620 Epoxy Resin Hardener (Reichold Chemical)
Paint Thinner 21-263 (PPG Industries)
2 - Propanol Solvent (Fisher)
Styrofoam Plastic Forms (Dow Chemical)
Varsol 1 Petroleum Solvent (Exxon)
Varsol 18 Petroleum Solvent (Exxon)

Figure 10
Sample Chemical Inventory List

SECTION THREE

CHEMICAL LABELS AND LISTS

ASSIGNMENT SHEET 1

1. List the information that must be given on a typical label.

2. List the three basic types of labeling systems.

3. Demonstrate how to read a label by completing Assignment Sheet 1 using the label given in Figure 2.

   a. What is the name of the product?

   b. Who makes it?

   c. What is the physical hazard from this product?

SECTION THREE

CHEMICAL LABELS AND LISTS

ASSIGNMENT SHEET 1 Continued

4. Demonstrate how to read a label by completing Assignment Sheet 1 using the label given in Figure 2.

   d. What are the health hazards?

   e. What are the target organs?

   f. What are the safe handling recommendations?

   g. What measures are to be used to limit worker exposure?

   h. What is the first aid information given?

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SECTION FOUR

CHEMICALS USED IN CONSTRUCTION

TRAINEE OBJECTIVES

At the conclusion of the session, trainees will be able to:

1. List three (3) common classes of hazardous chemicals or substances used on the construction site and give at least two examples of each.

2. Using the same three (3) classes of hazardous substances given in Objective 1, list the adverse health effects that can be caused by exposure to these chemicals.

3. Using the same three (3) classes of hazardous substances given in Objective 1, list the routes of entry and target organs when exposed to these substances.

4. Again using the same three (3) classes used in Objective 1, list how they are detected and the types of protection that are used to prevent exposure.

SECTION FOUR

CHEMICALS USED IN CONSTRUCTION

There are many hazardous chemicals used in construction that you may be exposed to. Most of these chemicals can be grouped into general categories that pose the same types of hazards. Grouping simplifies the difficulty in understanding the general hazards that you will encounter on the site.

The most common categories of hazardous chemicals found on construction sites follow:

- Concrete
- Fuels
- Solvents
- Wood
- Cleaners
- Adhesives and Sealants
- Acids, Bases, and Alkalies

CONCRETE

Cement products cause skin irritation. The more lime contained in cement, the more irritating it is to the skin. In addition, adding water to cement generates heat, thus increasing the possibility of reddening or burning of the skin upon contact.

When cement, with little moisture, comes into contact with the skin, the skin becomes hard, dry, and thickened. Then the dry skin often cracks and eventually ulcers may form. Cement also is irritating to the eyes, nose, and mouth.

When dry and set, as in pavement or blocks, concrete presents no health hazard to you. However, when concrete is cut, its dust can damage your respiratory system. Whenever you cut concrete, always try to use water as a containment and cooling agent. This will protect the cutting blade and keep dust levels lower. Use an appropriate dust mask (respirator) to protect your lungs when dust is produced.

Use proper personal hygiene and appropriate personal protective equipment to prevent cement's irritating alkaline effects.

SOLVENTS

A solvent is a liquid that dissolves another substance without changing the basic characteristic of either material. When the solvent evaporates, the original material is the same. In construction, we most often use solvents as cleaners, degreasers, thinners, fuels, and glues.

There are three main types or classes of solvents: (1) Water-containing or aqueous solutions such as acids, alkalies, and detergents; (2) Carbon-containing or organic solvents like acetone, toluene, and gasoline, and (3) Chlorine-containing or chlorinated solvents such as methylene-chloride and trichloroethylene.

The two most common ways solvents can enter into your body are by breathing or by skin contact.

Any solvent you breathe (inhalation) can cause dizziness or headaches as it affects your central nervous system. If you continue breathing in solvent vapors, you risk developing nose, throat, eye, and lung irritation, and damage to your liver, blood, kidneys, and digestive system.

Your body can absorb solvents that are in contact with the skin. Because solvents dissolve oils and greases, contact with your skin also can dry it out and produce irritation, cracking, and skin rashes. Once a solvent penetrates your skin, it enters your bloodstream and can attack your central nervous system and other body organs.

Like all chemicals, the effect upon you will depend on several factors--how toxic the chemical was, how long you were exposed, your own body's sensitivity, and how strong or concentrated the solvent was.

You can protect yourself from solvent hazards by following these simple rules:

- Know what chemicals you are using.
- Wear protective equipment like gloves, safety glasses, and proper respirators to prevent contact with your skin, eyes, and lungs.
- Ensure your work area has plenty of fresh air.
- Avoid skin contact with solvents.
- Wash with plenty of soap and water if your skin contacts the solvent.
- If a solvent splashes into your eye, flush with running water for a minimum of 15 minutes and get medical help.

Remember, never use gasoline as a solvent or cleaning agent.

CLEANERS

Cleaners contain acids, alkalies, aromatics, surfactants, petroleum products, ammonia, and hypochlorite. Because of these ingredients, cleaners are irritants, and can be harmful to you if swallowed or inhaled. Many cleaners cause eye, nose, throat, skin, and lung irritation. Some cleaners are flammable and burn easily. Others may be caustic or corrosive and cause severe skin damage.

Because many cleaners used in industrial situations are consumer products commonly found in our homes, you may underestimate the hazard they pose. **Protect yourself** from these chemicals by **reading** the labels and **following** recommended precautions. Wear gloves and eye protection. Avoid inhaling the vapors and mists. Wash your hands and face thoroughly before eating, drinking, or smoking. Do not eat, drink, or smoke where vapors, mists, and dust remain in the air.

Don't mix two cleaning chemicals together unless specifically told to do so by your supervisor. For example, if you mix bleach and ammonia or bleach and drain cleaner together, you will create chlorine gas. Chlorine gas is very dangerous. Because of the variety of cleaning materials in use, there are many signs and symptoms of overexposure. Read the MSDS for the particular product you are using.

ACIDS, BASES, ALKALI

Acids and bases (caustics) easily can damage the skin and eyes. The seriousness of the damage depends on the strength of the chemical, length of contact, and actions you take.

Acids and bases can be liquids, solid granules, powders, vapors, and gases. Sulfuric, hydrochloric, muriatic, and nitric acids are commonly used acids. Commonly used bases (caustics) are lye (sodium hydroxide) and potash (potassium hydroxide).

Both acids and bases can be corrosive, causing damage to whatever they touch. The more concentrated the chemical, the more dangerous it can be. Vinegar is a mild form of acetic acid and can be swallowed or rubbed on the skin with no damage. However, a concentrated solution of acetic acid can cause serious burns.

Different acids react differently when they contact your skin. Sulfuric acid mixes with water to produce heat; so when it contacts your skin, it reacts with moisture and causes burns. If hydrofluoric acid spills on your skin, you may not notice it, but hours later as the acid is absorbed into the muscle tissue, it can cause deep burns that are very painful and take a long time to heal or can even kill you. Acids in gas or vapor forms react with the moisture in your nose and throat causing irritation or damage. Acetic and nitric acid vapors don't react with the moisture in your nose and throat, but when they are inhaled they quickly penetrate into the lungs causing serious damage.

Bases, as a class of chemicals, feel slippery or soapy. Soap is made from a mixture of a base (lye) and animal fat. Concentrated bases dissolve tissue easily and, therefore, can cause severe skin damage on contact. Concentrated caustic gases, like ammonia vapors, can damage the skin, eyes, nose, mouth, and lungs. Even dry powder forms of bases can cause damage when you breathe them, because they react with the moisture in your skin, eyes, and respiratory tract.

Cement and mortar are alkali compounds in their wet or dry form. As dust and powder, they can damage your skin and eyes when they react with moisture in your body. Concrete and mortar also can cause allergic reactions in people who become sensitive to them.

Always follow these rules when working with acids and bases:

- Know what chemicals you are working with and how strong OR concentrated they are.
- Use Personal Protective Equipment, as required.
- In case of skin or eye contact, flush with cool water for at least 15 minutes. Do not rub your skin or eyes.
- Always add acid to the water to prevent splatter.
- Keep acids and bases apart. Store them separately and cleanup spills promptly. Acid and bases react, often violently, when mixed.

ADHESIVES AND SEALANTS

All adhesives and sealants have some type of hazard warning on the label. Because people often use them at home and on the job, warnings are taken lightly or ignored. However, adhesives and sealants are toxic because of their chemically reactive ingredients, or because of the solvent base that permits them to be applied more easily.

Adhesives or sealants that contain solvents may be flammable. Other types of adhesives, such as caulking or wood glue, may irritate eyes and skin. When working with any glue, avoid eye and skin contact. If the label says the adhesive is flammable, use and store it away from sources of ignition.

Epoxies contain epoxy amine resins and polyamide hardeners, each of which sensitizes skin and irritates your respiratory tract. Overexposure to epoxies can cause dizziness, drowsiness, nausea, and vomiting. Extreme or prolonged exposure can damage your kidney and liver.

Flooring adhesives may contain acrylics that irritate your skin and may cause nausea, vomiting, headache, weakness, asphyxia, and death. Other adhesives or sealants may contain coal tar derivatives that are suspected carcinogens. Avoid prolonged breathing of vapors or skin contact.

FUELS

The primary hazard posed by fuels is fire. Fuels either are flammable or combustible. Whether flammable (a material that ignites easily and burns rapidly) or combustible (a material that ignites at a higher temperature than a flammable), fuels should be handled with care.

Always store and transport fuel in approved, self-closing safety containers. When filling portable containers with flammable materials, properly ground and bond the container to prevent ignition caused by static electricity. Store gasoline in containers marked "Gasoline". Store kerosene in containers marked "Kerosene". Never use kerosene containers for the transport or storage of gasoline.

Excessive skin contact with fuels can result in dermatitis. Fuels entering the body through the skin and over a long period can break down the fatty tissues and possibly build-up in the body. Excessive inhalation of fuels may cause central nervous system depression and aggravation of any existing respiratory disease. Leukemia, a blood disorder that can lead to death, is a potential side-effect of chronic (long-term) exposure. Ingestion of fuels may cause poisoning and possible lung damage if aspirated into the lungs when ingested. Acute exposure to fuels may result in skin, lung, and respiratory tract irritation.

Do not pour waste fuel and flammable liquids down the drain. See the MSDS for proper waste disposal procedures.

When using portable containers, check that spark-arrestors are in place. When dispensing or using fuels, be aware of the location of fire extinguishers, fire alarms, and evacuation procedures. Fuels are flammable, so do not store, use, or dispense near arc welding or open flame. Use a bonding clamp to bond and ground containers when dispensing fuels. Remember, if you spill fuel, the vapors may travel some distance to an ignition source resulting in fire or an explosion.

Protect yourself from these chemicals by reading the labels and following the recommended precautions. Wear gloves and eye protection and avoid inhaling the vapors and mists. Wash your hands and face thoroughly before eating, drinking, or smoking.

Specific emergency procedures will be given on that fuel's Material Safety Data Sheet. In general, if fuel gets into your eyes, flush with clean running water for at least 15 minutes and then seek medical attention. If it gets on your skin, wash the area of contact.

WOOD

The primary concern is pressure treated lumber. It has been treated with a pesticide to protect it from insect attack or decay. It can be dangerous. The pressure treatment process uses inorganic arsenic, copper, zinc, a pesticide, or a combination of these, sometimes called CCA (chromated copper arsenate). The chemicals are forced deeply into the wood where they remain for a long time. As a result, treated wood, whether fresh from the lumber yard or found in an existing structure, can pose hazards to your health if not handled properly.

Avoid inhalation of sawdust from treated wood. When cutting, routing, sanding, or working with treated wood, wear a dust mask. Whenever possible, perform these operations outdoors to avoid indoor accumulations of airborne sawdust from treated wood. Keep bystanders, children, and pets from walking in the collected sawdust.

Some treated woods may appear damp and have chemical residue on the surface. Use gloves when handling freshly treated lumber and especially the sawdust from freshly treated wood. Wash hands and face thoroughly. Take meals and breaks away from the work area. Separate work clothing from other clothing and launder it before wearing it a second time.

Clean up all construction debris and dispose in ordinary trash collection. Do not burn pressure treated scraps in home stoves, fireplaces, or open fires, because the chemicals may become part of the smoke and ashes. Treated wood may be burned in commercial and industrial incinerators or boilers according, to state and federal regulations.

Do not use treated wood in circumstances where the wood will come in direct contact with food or with public drinking water sources.

Acute allergic reactions (hives, respiratory tract irrigation, general swelling) have been reported following contact with mahogany, birch, beech, and other untreated woods. To reduce the likelihood of such a reaction, use good personal hygiene. Upon completion of work, remove work clothing and launder separately from non-work clothing. Shower thoroughly to remove any material in contact with your skin.

TYPICAL CONSTRUCTION HAZARDOUS MATERIALS

Table 3 on the following pages provides a review of the typical hazardous substances used in construction arranged in groups. In that way, you have a general understanding of the hazards associated with these substances used on the job-site. This table is similar to the preceding sections except that: it covers more groups of hazardous materials used in construction and it summarizes the important information for you in a simple form and covers the following information:

Category	This is the group of similar products used for the same purpose, such as abrasives or fuels.
Examples	Examples of the commonly used products in the category are given here. For instance, under Fuels are listed diesel fuel, gasoline, kerosene, and propane.
Routes of Entry	This tells how these products might enter your body. Entry will be through your respiratory system (inhalation), your mouth (ingestion), your skin (absorption), or direct damage to your skin or eyes (such as an acid).
Physical Hazards	This tells you what properties of the product may present a physical threat to you. These include such things as the product's ability to burn, explode, and violently react with other chemicals, or whether it is a compressed gas.
Health Hazards	This tells you what effects the product may have on your body if you are overexposed to it. The chemical may be immediately damaging to your skin (acute) or may cause lung damage that will affect you years later (chronic). Health hazards may be acute and/or chronic.
Target Organs	This identifies the body's organs that are affected by the hazardous substance in the group if you are overexposed to the chemical.
How Detected	This is a very general guide as to how you might recognize this group of chemicals. For example, fuels are usually liquids that have a characteristic odor that we all recognize.
Types of Protection	This provides some general guidelines on protecting yourself if you are exposed to these materials. Respirators and ventilation protect the **lungs**; safety glasses, eye protection, and chemical goggles protect the **eyes**; gloves, protective clothing, and long-sleeved shirts protect the **skin**; while personal hygiene protects the **digestive system.** It notes when the material can be transferred from the air or your hands to food, drink, or smoking materials. When this is listed, make sure you wash up before eating, drinking, or smoking.

There are many hazardous chemicals used in construction. Most construction trades are exposed to a few. However, construction laborers may be exposed to all of them.

Use Table 3 as a general review of hazardous chemical information, but remember that the table does not contain all the potential substances you may work with. When you use or are exposed to a hazardous chemical on the job site, review the MSDS for that product. That specific information is important to you and your health, as it may be different from what is shown in the table. It may even be a new product for which information was not available when the table was prepared. If in doubt, check the MSDS when you use a hazardous chemical for the first time.

TABLE 3
TYPICAL HAZARDOUS SUBSTANCE CATEGORIES USED IN CONSTRUCTION

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Abrasives	Abrasive belts, disks, & wheels. Silica . Sandblasting.	Inhalation. Skin or eye contact.	Physical injury to skin and eyes.	Damage to skin, eyes, and lungs. Chronic lung disease. Cancer if removing nickel or chrome alloy metals or asbestos coatings.	Lungs. Eyes. Skin.	Airborne dust.	Ventilation. Respirators. Safety glasses. Faceshields. Gloves.
Adhesives and Solvents	Caulking, epoxy , plastic cement, flooring adhesives, super glue, urethane sealant, white glue.	Inhalation. Skin or eye contact. Ingestion.	Combustible. Flammable.	Damage to skin, eyes, and lungs. Skin sensitizers. Nervous system effects. Mucous membrane irritatant. Cancer. Toxic.	Lungs, kidney, liver, eyes, skin, central nervous system, peripheral nervous system.	Odor. Container. Usually liquids.	Ventilation. Respirators. Gloves. Eye protection. Personal hygiene.
Asbestos	Insulation on pipe, beams, ceilings, etc.	Inhalation.	None.	Damage to lungs. Cancer.	Lungs.	Unknown. Insulation, usually old and friable.	Training required by OSHA regulations. Contact a foreman if you suspect asbestos is present.
Asphalt Products	Asphalt, tar, creosote, cutback, pitch.	Inhalation. Skin and eye contact. Ingestion.	Combustible. Flammable.	Damage to skin, eyes, and lungs. Cancer. Irritant. Toxic.	Lungs, liver, kidneys, eyes, skin, brain, bladder, central nervous system.	Odor. Fumes. May be hot. Solid or liquid.	Personal hygiene. Ventilation. Gloves. Respirators. Coveralls Eye protection.
Biological Materials	Sewage, fecal matter, tetanus, rabies.	Inhalation. Ingestion. Skin contact.	None.	Localized skin infections. Infectious diseases.	Skin. Body in general depending upon the specific disease.	Work area. Animals when site clearing.	Personal hygiene. Gloves. Respirators. Tetanus immunization.
Cleaners	Bleach, drain & glass cleaner, germicide, metal polish, stain removers, cleaning sprays.	Inhalation. Ingestion. Skin or eye contact.	Flammable. Reactive.	Irritant to eyes, nose, throat, skin, and lungs. Corrosive. Damage to skin, eyes, and lungs.	Eyes. Lungs. Skin.	Odor. Container. Solids or liquids.	Personal hygiene. Gloves. Eye protection. Ventilation. Respirators.

TABLE 3
TYPICAL HAZARDOUS SUBSTANCE CATEGORIES USED IN CONSTRUCTION

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Coatings	Waterproofing, anti-corrosion, epoxies, polish, floor finish, varnish, waxes, cleaning spray, wood preservatives.	Inhalation. Ingestion. Skin and eye contact. Skin absorption.	Flammable. Combustible.	Irritant to eyes, skin, nose, lungs, and throat. Toxic. Cancer. Nervous system. Damage to reproductive organs. Reduced fertility. Birth defects. Damage to bone marrow.	Skin. Eyes. Lungs. Nervous system. Reproductive organs. Blood.	Odor. Container. Liquids.	Personal hygiene. Gloves. Ventilation. Eye protection. Respirators.
Fuels	Diesel fuel, gasoline, kerosene, propane.	Inhalation. Skin and eye contact. Ingestion.	Flammable. Combustible.	Damage to skin, eyes, and lungs. Toxic-ingestion. Central nervous system. Irritant. Cancer.	Skin. Eyes. Lungs. Central nervous system. Blood.	Odor. Liquids. Appearance.	Personal hygiene. Gloves. Ventilation. Eye protection. Approved containers. Ground & bond when filling.
Gases, compressed	Acetylene, oxygen, hydrogen, freon, ammonia propane, LPG, nitrogen	Inhalation. Skin and eye contact.	Flammable. Combustible. Oxidizer. Compressed gas.	Corrosive. Irritant. Damage to eyes and lungs. Asphyxiant. Heart attacks (freon). Toxic.	Skin. Eyes. Lungs. Central nervous system. Heart.	Odor (some). Compressed gas cylinder. Label on cylinder.	Handle, use, and store properly. Do not breathe gases. Use proper connections, equipment, & procedures.
Gases, noncompressed	Carbon monoxide nitrogen, hydrogen sulfide, Carbon dioxide.	Inhalation.	Flammable.	Asphyxiant. Toxic. Highly toxic.	Lungs. Blood. Central nervous system.	Odor (hydrogen sulfide-rotten eggs). Others-none.	Check confined spaces for O_2, other gases, & vapors before entering. Ventilation.
Insulation (non-asbestos)	Foam, graphite, fiberglass, rockwool, vermiculite, kaowool, inswool.	Inhalation. Skin and eye contact.	None.	Irritant. Damage to the lungs and eyes. Skin irritant.	Skin. Eyes. Lungs.	Package. Application area. Fibrous solids or foams.	Ventilation. Gloves. Long sleeve shirts. Respirators. Coveralls Eye protection. Personal hygiene including showers.
Lubricants	Oils, greases, cutting oils.	Inhalation. Skin and eye contact.	Combustible. Flammable.	Lung, skin, and eye irritatant. Cancer.	Skin. Eyes. Lungs.	Appearance. Container. Liquid is usually thick.	Gloves. Eye protection. Ventilation. Personal hygiene.

TABLE 3
TYPICAL HAZARDOUS SUBSTANCE CATEGORIES USED IN CONSTRUCTION

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Masonry	Brick, concrete, lime, mortar, muriatic acid, refractory brick, sand (silica), gunite refractory.	Inhalation. Skin and eye contact.	None.	Skin, eye, and lung irritation. Damage to lungs. Corrosive to lungs, skin, eyes and mucous membranes (muriatic acid).	Skin. Eyes. Lungs.	Physical appearance. Dust when cutting, gunning, etc. Solids except muriatic acid.	Gloves. Eye protection. Ventilation. Respirators. Personal hygiene. Chemical goggies when using acids.
Metals	Cadmium, galvanized metal, babbitt metal, lead, nickel, manganese, zinc, chromium.	Inhalation. Ingestion.	None as a solid metal. Many metal dusts are explosive.	Irritating to the lungs. Damage to the lungs. Cancer. Toxic. Highly toxic (cadmium fume and dust).	Lungs. Blood. Central nervous system.	Appearance. Solids. Often coated on other metals or alloyed with other metals.	Personal hygiene. Eye protection. Ventilation. Respirators.
Paint Products	Enamel, latex, thinners, lacquers, primers, cleaners, strippers, removers, turpintine.	Inhalation. Skin and eye contact.	Combustible. Flammable.	Due to the wide range of hazardous materials in these products, health hazards range from skin irritations, to coma or convulsions, and to cancer. Read MSDS for **each** product.	All body organs are possible target organs. See specific product MSDS's.	Appearance. Odor. Liquid or paste.	Ventilation. Respirators. Eye protection. Gloves. Personal hygiene. Protective clothing.
Pesticides Herbicides Fungicides	Baygon, DDVP, diazinon, parathion, many others.	Inhalation. Ingestion. Skin absorption.	Combustible. Flammable. Explosive.	Highly toxic. Toxic. Irritant.	Lungs. Blood. Central nervous system. Penetrates the skin.	Container that should have EPA label on it. Liquids or powders.	Personal hygiene. Respirators. Ventilation. Protective clothing. Eye protection. Use extra care when diluting/mixing concentrates.
Radioactive materials & Lasers	Lasers, soil or asphalt density instruments (radioactive source).	Eye and skin contact. Inhalation.	None.	Lasers - damage to the eyes or skin. Radioactive - damage to the skin, lungs, and all internal organs. Cancer.	Skin. Eyes. Lungs. Internal organs.	Warning labels on instruments using lasers or radioactive materials.	Do not handle, use, or service equipment unless trained to do so. Avoid eye exposure to laser beam and use proper eye protection if needed.

TABLE 3
TYPICAL HAZARDOUS SUBSTANCE CATEGORIES USED IN CONSTRUCTION

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Solvents	Acetone, ketone, hexane, toluene, xylene, mineral spirits, methyl ethyl alcohol, chlorinated solvents.	Inhalation. Skin and eye contact. Ingestion.	Combustible. Flammable.	Toxic. Cancer. Irritant. Damage to the skin.	Eyes. Lungs. Skin. Liver. Central nervous system. Kidneys. Peripheral neuropathy. Mucous membranes.	Odor. Liquids.	Ventilation. Respirators. Gloves. Protective clothing. Eye protection. Personal hygiene.
Welding Soldering Brazing Cutting	Electrodes, solders, fluxes, lead, metals, compressed gas, see listing above.	Inhalation. Skin and eye contact.	Compressed gases. Electrical & thermal burns.	Highly toxic fumes. Toxic fumes. Damage to eyes, skin, and lungs. Cancer. Irritant.	Eyes. Skin. Lungs. Liver. Central nervous system. Blood.	Appearance. Solids. Pastes (fluxes).	Ventilation. Special eye protection. Respirators. Protective clothing. Personal hygiene.
Wood products	Sawdust, pressure treated lumber, beech, mahogany.	Inhalation. Skin contact. Skin absorption. Ingestion.	Combustible.	Sensitization. Allergic reactions to some woods. Toxic.	Skin. Lungs. **Caution:** A number of body organs may be affected by the products used to treat wood. Avoid exposure to sawdust when cutting this wood.	Appearance. Pressure treated wood may have color when it is fresh.	Ventilation. Gloves. Eye protection. Personal hygiene. Respirators.

Notes:

1. **This review of typical hazards of hazardous materials used in construction is a general overview and may not be accurate for the specific product you may be using on the job site, or it may be a new product with different hazards than others in that general class. You should review the MSDS for *each product* you use, particularly the first time you use it.**
2. **Much of this information was adopted from Construction Industry Partnership for Protection through the courtesy of the Construction Advancement Program of Western Pennsylvania, sponsored by the Master Builders Association of Western Pennsylvania, Inc.**
3. **If you do not understand what some of these words mean, look them up in Appendix C.**

SECTION FOUR

CHEMICALS USED IN CONSTRUCTION

ASSIGNMENT SHEET 1

1. List three (3) common classes of hazardous chemicals or substances used on the construction site and give at least two examples of each.

2. Using the same three (3) classes of hazardous substances given in Objective 1, list the adverse health effects that can be caused by exposure to these chemicals.

3. Using the same three (3) classes of hazardous substances given in Objective 1, list the routes of entry and target organs when exposed to these substances.

4. Again using the same three (3) classes used in Objective 1, list how they are detected and the types of protection that are used to prevent exposure.

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APPENDIX A

29 CFR 1926.59 – HAZARD COMMUNICATION STANDARD

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(a) Purpose.

(1) The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training.

(2) This occupational safety and health standard is intended to address comprehensively the issue of evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, and to preempt any legal requirements of a state, or political subdivision of a state, pertaining to the subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to provisions for developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce, through any court or agency, any requirement relating to the issue addressed by this Federal standard, except pursuant to a Federally-approved state plan.

(b) Scope and Application.

(1) This section requires chemical manufacturers or importers to assess the hazards of chemicals which they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers.

(2) This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

(3) This section applies to laboratories only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees; and,

(iii) Employers shall ensure that laboratory employees are apprised of the hazards of the chemicals in their workplaces in accordance with paragraph (h) of this section.

(4) In work operations where employees only handle chemicals in sealed containers which are not opened under normal conditions of use (such as are found in marine cargo handling,

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warehousing, or retail sales), this section applies to these operations only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain copies of any material safety data sheets that are received with incoming shipments of the sealed containers of hazardous chemicals, shall obtain a material safety data sheet for sealed containers of hazardous chemicals received without a material safety data sheet if an employee requests the material safety data sheet, and shall ensure that the material safety data sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

(iii) Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section (except for the location and availability of the written hazard communication program under paragraph (h)(1)(iii)), to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

(5) This section does not require labeling of the following chemicals:

(i) Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

(ii) Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device, including materials intended for use as ingredients in such products (e.g. flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 *et seq.*) and regulations issued under that Act, when they are subject to the labeling requirements under that Act by the Food and Drug Administration;

(iii) Any distilled spirits (beverage alcohol), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 *et. seq.*) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Bureau of Alcohol, Tobacco, and Firearms; and,

(iv) Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et. seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Product Safety Commission.

(6) This section does not apply to:

(i) Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et. seq.), when subject to regulations issued under that Act by the Environmental Protection Agency;

(ii) Tobacco or tobacco products;

(iii) Wood or wood products;

(iv) Articles;

(v) Food, drugs, cosmetics, or alcoholic beverages in a retail establishment which are packaged for sale to consumers;

(vi) Foods, drugs, or cosmetics intended for personal consumption by employees while in the workplace;

(vii) Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 *et. seq.*) and Federal Hazardous Substances Act (15 U.S.C. 1261 *et. seq.*) respectively, where the employer can demonstrate it is used in the workplace in the same manner as normal consumer use, and which use results in a duration and frequency of exposure which is not greater than exposures experienced by consumers; and,

(viii) Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 *et. seq.*), when it is in solid, final form for direct administration to the patient (i.e. tablets or pills).

(c) Definitions.

"Article" means a manufactured item, other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which does not release more than minute quantities (i.e., a trace amount or a few molecules) of, or otherwise result in exposure to, a hazardous chemical (as determined under paragraph (d) of this section) under normal conditions of use.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Chemical" means any element, chemical compound or mixture of elements and/or compounds.

"Chemical manufacturer" means an employer with a workplace where chemical(s) are produced for use or distribution.

"Chemical name" means the scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

"Combustible liquid" means any liquid having a flashpoint at or above 100° F (37.8° C), but below 200° F (93.3° C), except any mixture having components with flashpoints of 200° F (93.3° C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Commercial account" means an arrangement whereby a retail distributor sells hazardous chemicals to an employer, generally in large quantities over time and at costs that are below the regular retail price.

"Common name" means any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70° F (21.1° C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130° F (54.4° C) regardless of the pressure at 70° F (21.1° C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100° F (37.8° C) as determined by ASTM D-323-72.

"Container" means any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle, are not considered to be containers.

"Designated representative" means any individual or organization to whom an employee gives written authorization to exercise such employee's rights under this section. A recognized or certified collective bargaining agent shall be treated automatically as a designated representative without regard to written employee authorization.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Distributor" means a business, other than a chemical manufacturer or importer, which supplies hazardous chemicals to other distributors or to employers.

"Employee" means a worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. Workers such as office workers or bank tellers who encounter hazardous chemicals only in non-routine, isolated instances are not covered.

"Employer" means a person engaged in a business where chemicals are either used, distributed, or are produced for use or distribution, including a contractor or subcontractor.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to a sudden shock, pressure, or high temperature.

"Exposure" or "exposed" means that an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.), and includes potential (e.g. accidental or possible) exposure.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening:

(ii) "Gas, flammable" means:

(a) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or

(b) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit;

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100° F (37.8° C), except any mixture having components with flashpoints of 100° F (37.8° C) or higher, the total of which make up 99 percent or more of the total volume of the mixture;

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in § 190.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tested, Z11.24-1979 (ASTM D 56-79)) for liquids with a viscosity of less than 45 Saybolt University Seconds (SUS) at 100° F (37.8° C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79)) for liquids with a viscosity equal to or greater than 45 SUS at 100° F (37.8° C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (See American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Foreseeable emergency" means any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

"Hazardous chemical" means any chemical which is a physical hazard or a health hazard.

"Hazard warning" means any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the specific physical and health hazard(s) (including target organ effects) of the chemical(s) in the container(s). (See the definitions for "physical hazard" and "health hazard" to determine the hazards which must be conveyed.)

"Health hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. Appendix A provides further definitions and explanations of the scope of health hazards covered by this section, and Appendix E describes the criteria to be used to determine whether or not a chemical is to be considered hazardous for purposes of this standard.

"Identity" means any chemical or common name which is indicated on the material safety data sheet (MSDS) for the chemical. The identity used shall permit cross-references to be made among the required list of hazardous chemicals, the label and the MSDS.

"Immediate use" means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

"Importer" means the first business with employees within the Customs Territory of the United States which receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States.

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"Label" means any written, printed or graphic material, displayed on or affixed to containers of hazardous chemicals.

"Material safety data sheet (MSDS)" means written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of this section. For hazardous chemicals which are drugs regulated by the Food and Drug Administration under the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 *et. seq.*), an approved package insert or drug information in the *Physicians' Desk Reference* will be considered an MSDS for purposes of compliance with this rule.

"Mixture" means any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

"Organic peroxide" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

"Produce" means to manufacture, process, formulate, or repackage.

"Pyrophoric" means a chemical that will ignite spontaneously in air at a temperature of 130° F (54.4° C) or below.

"Responsible party" means someone who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

"Specific chemical identity" means the chemical name, Chemical Abstracts Service (CAS) Registry Number, or any other information that reveals the precise chemical designation of the substance.

"Trade secret" means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D sets out the criteria to be used in evaluating trade secrets.

"Unstable (reactive)" means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.

"Use" means to package, handle, react, or transfer.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

"Work area" means a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

"Workplace" means an establishment, job site, or project, at one geographical location containing one or more work areas.

(d) Hazard Determination.

(1) Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to

evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

(2) Chemical manufacturers, importers or employers evaluating chemicals shall identify and consider the available scientific evidence concerning such hazards. For health hazards, evidence which is statistically significant and which is based on at least one positive study conducted in accordance with established scientific principles is considered to be sufficient to establish a hazardous effect if the results of the study meet the definitions of health hazards in this section. Appendix A shall be consulted for the scope of health hazards covered, and Appendix B shall be consulted for the criteria to be followed with respect to the completeness of the evaluation, and the data to be reported.

(3) The chemical manufacturer, importer, or employer evaluating chemicals shall treat the following sources as establishing that the chemicals listed in them are hazardous:

(i) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); or,

(ii) *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment,* American Conference of Government Industrial Hygienists (ACGIH) (latest edition).

The chemical manufacturer, importer, or employer is still responsible for evaluating the hazards associated with the chemicals in these source lists in accordance with the requirements of this standard.

(4) Chemical manufacturers, importers, and employers evaluating chemicals shall treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

(i) National Toxicology Program (NTP), *Annual Report on Carcinogens* (latest edition);

(ii) International Agency for Research on Cancer (IARC) *Monographs* (latest edition); or

(iii) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

Note--*The Registry of Toxic Effects of Chemical Substances* published by the National Institute for Occupational Safety and Health indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

(5) The chemical manufacturer, importer, or employer shall determine the hazards of mixtures of chemicals as follows:

(i) If a mixture has been tested as a whole to determine its hazards, the results of such testing shall be used to determine whether the mixture is hazardous;

(ii) If a mixture has not been tested as a whole to determine whether the mixture is a health hazard, the mixture shall be assumed to present the same health hazards as do the components which comprise one percent (by weight or volume) or greater of the mixture, except that the mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater which is considered to be a carcinogen under paragraph (d) (4) of this section;

(iii) If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is available to evaluate the physical hazard potential of the mixture; and,

(iv) If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent (or in the case of carcinogens, less than 0.1 percent) could be released in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health hazard to employees in those concentrations, the mixture shall be assumed to present the same hazard.

(6) Chemical manufacturers, importers, or employers evaluating chemicals shall describe in writing the procedures they use to determine the hazards of the chemical they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director. The written description may be incorporated into the written hazard communication program required under paragraph (e) of this section.

(e) Written Hazard Communication Program.

(1) Employers shall develop, implement, and maintain at the workplace, a written hazard communication program for their workplaces which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, material safety data sheets, and employee information and training will be met, and which also includes the following:

(i) A list of the hazardous chemicals known to be present using an identity that is referenced on the appropriate material safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

(ii) The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

(2) Multi-employer workplace. Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:

(i) The methods the employer will use to provide the other employer(s) with a copy of the material safety data sheet, or to make it available at a central location in the workplace, for each hazardous chemical the other employer(s)' employees may be exposed to while working;

(ii) The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

(iii) The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

(3) The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).

(4) The employer shall make a written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.20(e).

(f) Labels and Other Forms of Warning.

(1) The chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked with the following information:

(i) Identity of the hazardous chemical(s);

(ii) Appropriate hazard warnings;

(iii) Name and address of the chemical manufacturer, importer, or other responsible party.

(2) For solid metal (such as a steel beam or a metal casting) that is not exempted as an article due to its downstream use, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes. The label may be transmitted with the initial shipment itself, or with the material safety data sheet that is to be provided prior to or at the time of the first shipment. This exception to requiring labels on every container of hazardous chemicals is only for the solid metal itself and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the metal and to which employees handling the metal may be exposed (for example, cutting fluids or lubricants).

(3) Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 *et seq.*) and regulations issued under that Act by the Department of Transportation.

(4) If the hazardous chemical is regulated by OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor, or employer shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

(5) Except as provided in paragraphs (f)(6) and (f)(7) the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged, or marked with the following information:

(i) Identity of the hazardous chemical(s) contained therein; and

(ii) Appropriate hazard warnings.

(6) The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(5) of this section to be on a label. The written materials shall be readily accessible to the employees in their work area throughout each work shift.

(7) The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are

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intended only for the immediate use of the employee who performs the transfer.

(8) The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals unless the container is immediately marked with the required information.

(9) The employer shall ensure that labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

(10) The chemical manufacturer, importer, distributor, or employer need not affix new labels to comply with this section if existing labels already convey the required information.

(g) Material Safety Data Sheets.

(1) Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Employers shall have a material safety data sheet for each hazardous chemical which they use.

(2) Each material safety data sheet shall be in English and shall contain at least the following information:

(i) The identity used on the label, and, except as provided for in paragraph (i) of this section on trade secrets:

(a) If the hazardous chemical is a single substance, its chemical and common name(s);

(b) If the hazardous chemical is a mixture which has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients which contribute to these known hazards, and the common name(s) of the mixture itself; or,

(c) If the hazardous chemical is a mixture which has not been tested as a whole;

(*1*) The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise 1% or greater of the composition, except that chemicals identified as carcinogens under paragraph (d) (4) of this section shall be listed if the concentrations are 0.1% or greater; and,

(*2*) The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise less than 1% (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations which would exceed an established OSHA Permissible Exposure Limit or ACGIH Threshold Limit Value, or could present a health hazard to employees; and,

(*3*) The chemical and common name(s) of all ingredients which have been determined to present a physical hazard when present in the mixture;

(ii) Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

(iii) The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity:

(iv) The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical;

(v) The primary route(s) of entry;

(vi) The OSHA Permissible Exposure Limit, ACGIH Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the material safety data sheet, where available;

(vii) Whether the hazardous chemical is listed in the National Toxicology Program (NTP) *Annual Report on Carcinogens* (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) *Monographs* (latest editions), or by OSHA;

(viii) Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer, or employer preparing the material safety data sheet, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;

(ix) Any generally applicable control measures which are known to the chemical manufacturer, importer, or employer preparing the material safety data sheet, such as appropriate engineering controls, work practices, or personal protective equipment;

(x) Emergency and first aid procedures;

(xi) The date of preparation of the material safety data sheet or the last change to it; and,

(xii) The name, address, and telephone number of the chemical manufacturer, importer, employer, or other responsible party preparing or distributing the material safety data sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

(3) If no relevant information is found for any given category on the material safety data sheet, the chemical manufacturer, importer, or employer preparing the material safety data sheet shall mark it to indicate that no applicable information was found.

(4) Where complex mixtures have similar hazards and contents (i.e. the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer, or employer may prepare one material safety data sheet to apply to all of these similar mixtures.

(5) The chemical manufacturer, importer, or employer preparing the material safety data sheet shall ensure that the information recorded accurately reflects the scientific evidence used in making the hazard determination.

If the chemical manufacturer, importer, or employer preparing the material safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the material safety data sheet within three months. If the chemical is not currently being produced or imported the chemical manufacturer or importer shall add the information to the material safety data sheet before the chemical is introduced into the workplace again.

(6) Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate material safety data sheet with their initial shipment, and with the first shipment after a material safety data sheet is updated. The chemical manufacturer or importer shall either

provide material safety data sheets with the shipped containers or send them to the employer prior to or at the time of the shipment. If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the employer shall obtain one from the chemical manufacturer, importer, or distributor as soon as possible.

(7) Distributors shall ensure that material safety data sheets, and updated information, are provided to other distributors and employers. Retail distributors which sell hazardous chemicals to commercial customers shall provide a material safety data sheet to such employers upon request, and shall post a sign or otherwise inform them that a material safety data sheet is available. Chemical manufacturers, importers, and distributors need not provide material safety data sheets to retail distributors which have informed them that the retail distributor does not sell the product to commercial customers or open the sealed container to use it in their own workplaces.

(8) The employer shall maintain copies of the required material safety data sheets for each hazardous chemical in the workplace, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s).

(9) Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at a central location at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

(10) Material safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in their work area(s).

(11) Material safety data sheets shall also be made readily available, upon request, to designated representatives and to the Assistant Secretary, in accordance with the requirements of 29 CFR 1910.20(e). The Director shall also be given access to material safety data sheets in the same manner.

(h) Employee Information and Training.

Employers shall provide employees with information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new hazard is introduced into their work area.

(1) Information. Employees shall be informed of:

(i) The requirements of this section;

(ii) Any operations in their work area where hazardous chemicals are present; and,

(iii) The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and material safety data sheets required by this section.

(2) Training. Employee training shall include at least:

(i) Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(ii) The physical and health hazards of the chemicals in the work area;

(iii) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

(iv) The details of the hazard communication program developed by the employer, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

(i) Trade Secrets.

(1) The chemical manufacturer, importer, or employer may withhold the specific chemical identity, including the chemical name and other specific identification of a hazardous chemical from the material safety data sheet, provided that:

(i) The claim that the information withheld is a trade secret can be supported;

(ii) Information contained in the material safety data sheet concerning the properties and effects of the hazardous chemical is disclosed;

(iii) The material safety data sheet indicates that the specific chemical identity is being withheld as a trade secret; and,

(iv) The specific chemical identity is made available to health professionals, employees, and designated representatives in accordance with the applicable provisions of this paragraph.

(2) Where a treating physician or nurse determines that a medical emergency exists and the specific chemical identity of a hazardous chemical is necessary for emergency or first-aid treatment, the chemical manufacturer, importer, or employer shall immediately disclose the specific chemical identity of a trade secret chemical to that treating physician or nurse, regardless of the existence of a written statement of need of a confidentiality agreement. The chemical manufacturer, importer, or employer may require a written statement of need and confidentiality agreement, in accordance with the provisions of paragraphs (i)(3) and (4) of this section, as soon as circumstances permit.

(3) In non-emergency situations, a chemical manufacturer, importer, or employer shall, upon request, disclose a specific chemical identity, otherwise permitted to be withheld under paragraph (i)(1) of this section, to a health professional (i.e. physician, industrial hygienist, toxicologist, epidemiologist, or occupational health nurse) providing medical or other occupational health services to exposed employee(s), and to employees or designated representatives, if:

(i) The request is in writing;

(ii) The request describes with reasonable detail one or more of the following occupational health needs for the information:

(a) To assess the hazards of the chemicals to which employees will be exposed;

(b) To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels;

(c) To conduct pre-assignment or periodic medical surveillance of exposed employees;

(d) To provide medical treatment to exposed employees;

(e) To select or assess appropriate personal protective equipment for exposed employees;

(f) To design or assess engineering controls or other protective measures for exposed employees; and,

(g) To conduct studies to determine the health effects of exposure.

(iii) The request explains in detail why the disclosure of the specific chemical identity is essential and that, in lieu thereof, the disclosure of the following information to the health professional, employee, or designated representative, would not satisfy the purposes described in paragraph (i)(3)(ii) of this section:

(a) The properties and effects of the chemical;

(b) Measures for controlling workers' exposure to the chemical;

(c) Methods of monitoring and analyzing worker exposure to the chemical; and,

(d) Methods of diagnosing and treating harmful exposures to the chemical;

(iv) The request includes a description of the procedures to be used to maintain the confidentiality of the disclosed information; and,

(v) The health professional, and the employer or contractor of the services of the health professional (i.e. downstream employer, labor organization, or individual employee), employee, or designated representative, agree in a written confidentiality agreement that the health professional, employee, or designated representative, will not use the trade secret information for any purpose other than the health need(s) asserted and agree not to release the information under any circumstances other than to OSHA, as provided in paragraph (i)(6) of this section, except as authorized by the terms of the agreement or by the chemical manufacturer, importer, or employer.

(4) The confidentiality agreement authorized by paragraph (i)(3)(iv) of this section;

(i) May restrict the use of the information to the health purposes indicated in the written statement of need;

(ii) May provide for appropriate legal remedies in the event of a breach of the agreement, including stipulation of a reasonable pre-estimate of likely damages; and,

(iii) May not include requirements for the posting of a penalty bond.

(5) Nothing in this standard is meant to preclude the parties from pursuing non-contractual remedies to the extent permitted by law.

(6) If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to OSHA, the chemical manufacturer, importer, or employer who provided the information shall be informed by the health professional, employee, or designated representative prior to, or at the same time as, such disclosure.

(7) If the chemical manufacturer, importer, or employer denies a written

request for disclosure of a specific chemical identity, the denial must:

(i) Be provided to the health professional, employee, or designated representative, within thirty days of the request;

(ii) Be in writing;

(iii) Include evidence to support the claim that the specific chemical identity is a trade secret;

(iv) State the specific reasons why the request is being denied; and,

(v) Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the specific chemical identity.

(8) The health professional, employee, or designated representative whose request for information is denied under paragraph (i)(3) of this section may refer to the request and the written denial of the request to OSHA for consideration.

(9) When a health professional, employee, or designated representative refers the denial to OSHA under paragraph (i)(8) of this section, OSHA shall consider the evidence to determine if:

(i) The chemical manufacturer, importer, or employer has supported the claim that the specific chemical identity is a trade secret;

(ii) The health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information; and,

(iii) The health professional, employee, or designated representative has demonstrated adequate means to protect the confidentiality.

(10) (i) If OSHA determines that the specific chemical identity requested under paragraph (i)(3) of this section is not a *bona fide* trade secret, or that it is a trade secret, but the requesting health professional, employee, or designated representative has a legitimate medical or occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means to protect the confidentiality of the information, the chemical manufacturer, importer, or employer will be subject to citation by OSHA.

(ii) If a chemical manufacturer, importer, or employer demonstrates to OSHA that the execution of a confidentiality agreement would not provide sufficient protection against the potential harm from the unauthorized disclosure of a trade secret specific chemical identity, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health services are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

(11) If a citation for a failure to release specific chemical identity information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act's enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation *in camera* or issue appropriate orders to protect the confidentiality of such matters.

(12) Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information which this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

(13) Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process or percentage of mixture information which is a trade secret.

(j) Effective Dates.

(1) Chemical manufacturers, importers, and distributors shall ensure that material safety data sheets are provided with the next shipment of hazardous chemicals to employers after September 23, 1987.

(2) Employers in the non-manufacturing sector shall be in compliance with all provisions of this section by May 23, 1988. (Note: Employers in the manufacturing sector (SIS Codes 20 through 39) are already required to be in compliance with this section.)

APPENDIX A TO § 1926.59
HEALTH HAZARD DEFINITIONS
(MANDATORY)

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g. flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body -- such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees -- such as shortness of breath, a non-measurable, subjective feeling. Employees exposed to such hazards must be apprised of both the change in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in non-occupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data does not exist to substantiate these effects.

There have been may attempts to categorize effects and to define them in various ways. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration. "Acute" effects usually occur rapidly as a result of short-term exposures, and are of short duration. "Chronic" effects generally occur as a result of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1982) -- irritation, corrosivity, sensitization and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects which may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the area of chronic effects, excluding, for example, blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them. Appendix B, which is also mandatory, outlines the principles and procedures of hazardous assessment.

For purposes of this section, any chemicals which meet any of the following definitions, as determined by the criteria set forth in Appendix B are health hazards:

1. *Carcinogen:* A chemical is considered to be a carcinogen if:

(a) It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or

(b) It is listed as a carcinogen or potential carcinogen in the *Annual Report on Carcinogens* published by the National Toxicology Program (NTP) (latest edition); or,

(c) It is regulated by OSHA as a carcinogen.

2. *Corrosive:* A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.

3. *Highly toxic:* A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

4. *Irritant:* A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

5. *Sensitizer:* A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

6. *Toxic:* A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

7. *Target organ effects:* The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

a. Hepatotoxins: Chemicals which produce liver damage
   Signs & Symptoms: Jaundice; liver enlargement
   Chemicals: Carbon tetrachloride; nitrosamines

b. Nephrotoxins: Chemicals which produce kidney damage
   Signs & Symptoms: Edema; proteinuria
   Chemicals: Halogenated hydrocarbons; uranium

c. Neurotoxins: Chemicals which produce their primary toxic effects on nervous system
   Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions
   Chemicals: Mercury; carbon disulfide

d. Agents which act on the blood or hematopoietic system: Decrease hemoglobin function; deprive the body tissues of oxygen
   Signs & Symptoms: Cyanosis; loss of consciousness
   Chemicals: Carbon monoxide; cyanides

e. Agents which damage the lung: Chemicals which irritate or damage the pulmonary tissue
   Signs & Symptoms: Cough; tightness in chest; shortness of breath
   Chemicals: Silica; asbestos

f. Reproductive toxins: Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)
   Signs & Symptoms: Birth defects; sterility
   Chemicals: Lead; DBCP

g. Cutaneous hazards: Chemicals which affect the dermal layer of the body
   Signs & Symptoms: Defatting of the skin; rashes; irritation
   Chemicals: Ketones; chlorinated compounds

h. Eye hazards: Chemicals which affect the eye or visual capacity
   Signs & Symptoms: Conjunctivitis; corneal damage
   Chemicals: Organic solvents; acids

APPENDIX B TO § 1926.59 HAZARD DETERMINATION (MANDATORY)

The quality of a hazard communication program is largely dependent upon the adequacy and accuracy of the hazard determination. The hazard determination requirement of this standard is performance-oriented. Chemical manufacturers, importers, and employers evaluating chemicals are not required to follow any specific methods for determining hazards, but they must be able to demonstrate that they have adequately ascertained the hazards of the chemicals produced or imported in accordance with the criteria set forth in this Appendix.

Hazard evaluation is a process which relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance-orientation of the hazard determination does not diminish the duty of the chemical manufacturer, importer, or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

1. *Carcinogenicity:* As described in paragraph (d)(4) and Appendix A of this section, a determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this section.

2. *Human data:* Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

3. *Animal data:* Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results (see Appendix A).

4. *Adequacy and reporting of data:* The results of any studies which are designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. The chemical manufacturer, importer, or employer may also report the results of other scientifically valid studies which tend to refute the findings of hazard.

APPENDIX C TO § 1926.59 INFORMATION SOURCES (ADVISORY)

The following is a list of available data sources which the chemical manufacturer, importer, distributor, or employer may wish to consult to evaluate the hazards of chemicals they produce or import:

-- Any information in their own company files, such as toxicity testing results or illness experience of company employees.

-- Any information obtained from the supplier of the chemical, such as material safety data sheets or product safety bulletins.

-- Any pertinent information obtained from the following source list (latest editions should be used):

Condensed Chemical Dictionary
Van Nostrand Reinhold Co., 135 West 50th Street, New York, NY 10020.

The Merck Index: An Encyclopedia of Chemicals and Drugs
Merck and Company, Inc., 126 E. Lincoln Ave., Rahway, NJ 07065.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man
Geneva: WHO, International Agency for Research on Cancer, 1972-Present. (Multivolume work). Summaries are available in supplement volumes. 49 Sheridan Street, Albany, NY 12210.

Industrial Hygiene and Toxicology, by F. A. Patty
John Wiley & Sons, Inc., New York, NY (Multivolume work).

Clinical Toxicology of Commercial Products
Gleason, Gosselin, and Hodge.

Casarett and Doull's Toxicology; The Basic Science of Poisons
Doull, Klaassen, and Amdur, Macmillan Publishing Co., Inc., New York, NY.

Industrial Toxicology, by Alice Hamilton and Harriet L. Hardy
Publishing Sciences Group, Inc., Acton, MA.

Toxicology of the Eye, by W. Morton Grant
Charles C. Thomas, 301-327 East Lawrence Avenue, Springfield, IL.

Recognition of Health Hazards in Industry
William A. Burgess, John Wiley and Sons, 605 Third Avenue, New York, NY 10158.

Chemical Hazards of the Workplace
Nick H. Proctor and James P. Hughes, J.P. Lipincott Company,
6 Winchester Terrace, New York, NY 10022.

Handbook of Chemistry and Physics
Chemical Rubber Company, 18901 Cranwood Parkway, Cleveland, OH 44128.

Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices with Intended Changes
American Conference of Governmental Industrial Hygienists (ACGIH). 6500 Glenway Avenue, Bldg. D-5, Cincinnati, OH 45211.

Information on the physical hazards of chemicals may be found in publications of the National Fire Protection Association, Boston, MA.

Note: The following documents may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Occupational Health Guidelines
NIOSH/OSHA (NIOSH Pub. No. 81-123)

NIOSH Pocket Guide to Chemical Hazards
NIOSH Pub. No. 85-114

Registry of Toxic Effects of Chemical Substances
NIOSH Pub. No. 80-102

Miscellaneous Documents
published by the National Institute for Occupational Safety and Health: Criteria documents.
Special Hazard Reviews.
Occupational Hazard Assessments.
Current Intelligence Bulletins.

OSHA's General Industry Standards (29 CFR Part 1910)

NTP Annual Report on Carcinogens and *Summary of the Annual Report on Carcinogens.*
National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650.

BIBLIOGRAPHIC DATA BASES

Service Provider	File Name
Bibliographic Retrieval Services (BRS), 1200 Route 7, Latham, NY 12110. NTIS	Biosis Previews CA Search Medlars Hazardline American Chemical Society Journal Excerpta Medica IRCS Medical Science Journal Pre-Med Intl. Pharmaceutical Abstracts Paper Chem
Lockheed-DIALOG Information Service, Inc., 3460 Hillview Avenue, Palo Alto, CA 94304.	Biosis Prev. Files CA Search Files CAB Abstracts Chemical Exposure Chemname Chemsis Files Chemzero Embase Files Environmental Bibliographies Enviroline Federal Research in Progress IRL Life Science Collection NTIS Occupational Safety & Health (NIOSH) Paper Chem
SDC-Orbit, SDC Information Service, 2500 Colorado Avenue, Santa Monica, CA 90406	CAS Files Chemdex, 2, 3 NTIS

BIBLIOGRAPHIC DATA BASES Continued

Service Provider	File Name
National Library of Medicine, Department of Health and Human Services, Public Health Service, National Institute of Health, Bethesda, MD 20209.	Hazardous Substance Data Bank (NSDB) Medline Files Toxline Files Cancerlit RTECS Chemline
Pergamon International Information Corp., 1340 Old Chain Bridge Rd., McLean, VA 22101.	Laboratory Hazard Bulletin
Questel, Inc., 1625 Eye Street, NW, Suite 818, Washington, DC 20006.	CIS/ILO Cancernet
Chemical Information System ICI (ICIS), Bureau of National Affairs, 1133 15th Street, NW, Suite 300, Washington, DC 20005.	Structure and Nomenclature Search System (SANSS) Acute Toxicity (RTECS) Clinical Toxicology of Commercial Products Oil and Hazardous Materials Technical Assistance Data System CCRIS CESARS
Occupational Health Services, 400 Plaza Drive, Secaucus, NJ 07094.	MSDS Hazardline

APPENDIX D TO § 1926.59
DEFINITION OF "TRADE SECRET"
(MANDATORY)

The following is a reprint of the *Restatement of Torts* section 757, comment *b* (1939):

b. *Definition of trade secret.* A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating, or preserving materials, a pattern for a machine or other device, or a list of customers. It differs from other secret information in a business (see § 759 of the *Restatement of Torts* which is not included in this Appendix) in that it is not simply information as to single or ephemeral events in the conduct of the business, as, for example, the amount or other terms of a secret bid for a contract or the salary of certain employees, or the security investments made or contemplated, or the date fixed for the announcement of a new policy or for bringing out a new model or the like. A trade secret is a process or device for continuous use in the operations of the business. Generally it relates to the production of goods, as, for example, a machine or formula for the production of an article. It may, however, relate to the sale of goods or to other operations in the business, such as a code for determining discounts, rebates or other concessions in a price list or catalogue, or a list of specialized customers, or a method of bookkeeping or other office management.

Secrecy. The subject matter of a trade secret must be secret. Matters of public knowledge or of general knowledge in an industry cannot be appropriated by one as his secret. Matters which are completely disclosed by the goods which one markets cannot be his secret. Substantially, a trade secret is known only in the particular business in which it is used. It is not requisite that only the proprietor of the business know it. He may, without losing his protection, communicate it to employees involved in its use. He may likewise communicate it to others pledged to secrecy. Others may also know of it independently, as, for example, when they have discovered the process or formula by independent invention and are keeping it secret. Nevertheless, a substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring the information. An exact definition of a trade secret is not possible. Some factors to be considered in determining whether given information is one's trade secret are: (1) The extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with which the information could be properly acquired or duplicated by others.

Novelty and prior art. A trade secret may be a device or process which is patentable; but it need not be that. It may be a device or process which is clearly anticipated in the prior art or one which is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability. These requirements are essential to patentability because a patent protects against unlicensed use of the patented device or process even by one who discovers it properly through independent research. The patent monopoly is a reward to the inventor. But such is not the case with a trade secret. Its protection is not based on a policy of rewarding or otherwise encouraging the development of secret processes or devices. The protection is merely against breach of faith and reprehensible means of learning another's secret. For this limited protection it is not appropriate to require also the kind of novelty and invention which is a requisite of patentability. The nature of the secret is, however, an important factor in determining the kind of relief that is appropriate against one who is subject to liability under the rule stated in this section. Thus, if the secret consists of a device or process which is a novel invention, one who acquires the secret wrongfully is ordinarily enjoined from further use of it and is required to account for the profits derived from his past use. If, on the other hand, the secret consists of mechanical improvements that a good mechanic can make without resort to the secret, the wrongdoer's liability may be limited to damages, and an injunction against future use of the improvements made with the aid of the secret may be inappropriate.

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APPENDIX B

SAMPLE WRITTEN HAZARD COMMUNICATION PROGRAM

This working guideline is offered to CAP Contributors to assist in the development of a compliance program set forth by the Federal Occupational Safety and Health Administration's Hazard Communication Standard (29 CFR 1926.59). It represents an application of the Standard which attempts to address the uniqueness of the construction industry, and the intent of the Law. (This proposed program should be supplemented by company personnel and professional guidance; tailor-fitting it to your particular company.) The Construction Advancement Program of Western Pennsylvania (CAP) provides no warranty or guarantee, either expressed or implied, for the program's performance for any particular purpose. No liability for inaccuracies or defects to the Hazard Communication Program can be assumed by CAP. It is rather a guideline, which, to the best of our knowledge, addresses the issues and intent of the Law.

COMPANY POLICY

People are our most important resource, and their health and safety is one of Name of Company's principal responsibilities and primary concerns. Safety must be made an integral part of all operations, whether it be in planning and development or contracting.

Name of Company proven safety record reflects the management's commitment to employee welfare. However, I want to take this opportunity to reaffirm my belief in a strong safety and health program which will continue to create, and thus provide, a safe place for all employees to work. Accidents and chemical exposures cost time and money, but more importantly, they can cause personal loss and unnecessary injury, which has no price.

I hope you will share my concern for providing a safe working environment; because a safety and health program's effectiveness depends upon the cooperation and concern of employees and management personnel who are knowledgeable of the potential hazards of chemical use in the workplace.

____

Name and Signature of Company President

COMPANY COMMITMENT

Name of Company is committed to providing each of its employees a safe and healthy work environment. Construction processes and other operations performed at the various *Name of Company* jobsites sometimes require the use of materials and chemicals that can be hazardous, if not handled properly. When using these substances, it is important that workers are aware of the identity of the substances, as well as the toxic or other hazardous properties of the chemicals; since an informed employee is more likely to be a careful employee. Therefore, in an effort to promote and maintain jobsites that are free from controllable safety and health hazards, the *Name of Company* has implemented this Hazard Communication Program to protect its employees.

EMPLOYEE RESPONSIBILITY

The success of this Hazard Communication Program depends to a great extent upon the cooperation of every employee. Employees should: be alert to the potential hazards in their work areas; know and understand the hazards of those chemicals; consult the Material Safety Data Sheets (MSDS) for the specifics concerning the hazardous chemicals with which they work; follow the appropriate safe working procedures that have been established; wear required personal protective equipment; and actively participate in the training programs implemented to protect their health and safety.

Active employee participation in *Name of Company* Hazard Communication Program will result in the continued reduction of the incidence of chemical related illnesses and injuries at *Name of Company* jobsites and facilities. This written program will be available at the *Location* for review by any interested employee. A master copy of this program will also be maintained at the *Name of Company* main office.

PROGRAM MANAGER/COORDINATOR

The Program Manager/Coordinator of the OSHA Hazard Communication Program is *Name/Title*; who can be reached at the following telephone number _______________ during the normal office hours of ________ to ________ Monday through Friday. In the case of emergencies outside the normal office hours, call _______________.

The Program Manager/Coordinator is responsible for the effective implementation of this Program.

The Program Manager/Coordinator will periodically report to management regarding the Program's implementation, effectiveness and continuing update requirements. The Program Manager/Coordinator will establish the specifics of the "Hazard Communication" Policy and coordinate the efforts and activities of employees and management.

CHEMICAL INVENTORY

The Program Manager/Coordinator is responsible for developing and compiling a hazardous chemical inventory list which identifies all hazardous chemicals used by *Name of Company* employees. This list will be contained within the written program and updated periodically to ensure completeness.

The list will also be posted at *location* for employee information. Copies will be provided to any *Name of Company* employee or his/her authorized representative upon request to *Person/position*.

MATERIAL SAFETY DATA SHEET (MSDS) POLICY

The Program Manager/Coordinator has the overall responsibility for establishing and monitoring the MSDS Program. He/She will ensure that procedures are developed to obtain the necessary MSDS's for all substances and chemicals which are known to pose a health or physical hazard to employees who are exposed to them. He/She will review all incoming or updated MSDS's for new or significant health and safety information and pass it on to affected employees. A master copy of all complete and current MSDS's will be maintained and updated as necessary by the Program Manager/Coordinator. The Program Manager/Coordinator will assign responsibilities to appropriate on-site supervisory personnel for MSDS maintenance at each jobsite. He/She will ensure that current MSDS's for all chemicals and substances at the site are available to employees. If an MSDS is not available upon request, the Program Manager/Coordinator should be contacted. Periodically, site personnel shall check the MSDS collection for completeness.

CONTAINER LABELING POLICY

The Program Manager/Coordinator is responsible for adopting and enforcing *Name of Company* in-house labeling system. In general, *Name of Company* will rely on the manufacturer's applied labels whenever possible and will ensure that these labels are maintained in a legible condition. Containers which are not labeled or on which the manufacturer's label has been removed will be relabeled. *Name of Company* will ensure that each container is labeled with the identity of the hazardous chemical contained and any appropriate hazard warnings.

The *person/position* will verify that all containers received from manufacturers, suppliers, or importers used by employees are clearly and appropriately labeled. All chemicals on site will be stored in their original or approved containers with proper labels attached. Any container not labeled should be given to *person/position* for labeling or proper disposal. Workers may dispense chemicals from original containers only in small quantities intended for immediate use. Any chemical left after work is completed must be returned to the original container or *person/position* for proper handling. At no time should any unmarked containers of any size be left in the work area after work is completed. *Person/position* has the responsibility of monitoring and notifying the Program Manager/Coordinator of any on-site deficiencies which occur during day-to-day operations.

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EMPLOYEE INFORMATION

Employees will be informed of, and will have access to, all relevant information, including this document and the standard itself, which can be found on the jobsite or in the office of the Program Manager/Coordinator. MSDS's are located in master copy form in the Program Manager/Coordinator's office. Relevant copies of a particular MSDS are made available to employees or their authorized representative upon request. Information pertaining to operations in which hazardous chemicals are present will also be provided to employees.

EMPLOYEE TRAINING

The Hazard Communication Program Manager/Coordinator is responsible for the effective dissemination of *Name of Company* employee training and information programs.

Employees will be trained to work safely with hazardous chemicals. Employee training shall include:

1. An overview of the requirements contained in the Hazard Communication Standard.
2. The locations of the MSDS file and written Hazard Communication Program.
3. The content and importance of Material Safety Data Sheets and labels.
4. The methods and observations that may be used to detect the presence or release of a hazardous chemical.
5. Physical and health hazards associated with chemicals.
6. Methods used to protect employees.
7. Safe work procedures, emergency responses and use of personal protective equipment.

Every *Name of Company* employee is required to actively participate in *Name of Company* hazard communication training programs.

HAZARDOUS NON-ROUTINE TASKS

Periodically, employees are required to perform hazardous non-routine work. It is *Name of Company* policy that such operations not be undertaken until the employees have been provided information on the possible undesirable effects that may arise during such operations. Prior to starting the work, each affected employee will be given this information by the *Person/position*. This information will include the chemical and physical hazards associated with the chemical, required personal protective equipment use, and the steps that the company is using to reduce the hazards. When necessary, areas will be posted to indicate the nature of the hazard involved.

EMERGENCY PROCEDURES

In the event of an overexposure to or spill of any hazardous chemical, the *Name/position* will be notified at once. The foreman or the immediate supervisors will be responsible for insuring that proper and appropriate emergency response actions are taken. The appropriate Material Safety Data Sheet pertaining to that chemical or substance will serve as reference for such actions.

MULTI-EMPLOYER JOBSITES

It is the policy of *Name of Company* to adequately apprise other contractors regarding the hazardous substance which their employees may be exposed to during the course of day-to-day construction activities. Contractors, whose employees may be exposed to hazardous substances used by *Name of Company* employees, will be given access to this Hazard Communication Program. This will provide all relevant chemical information necessary to protect their employees.

Contractors should be informed of conditions existing on-site which necessitate special precautionary measures through weekly safety or tool box meetings.

Other on-site employers working among *Name of Company* employees, are also required to adhere to the provisions of the Hazard Communication Standard. They shall make available copies of MSDS's for all hazardous materials used by their employees which can be reviewed by *Name of Company* employees. MSDS's will be provided within a reasonable time period after such a request.

The *Name of Company* is firmly committed to its employees' health and safety, and as such requires all contractors whose employees work around and among *Name of Company* employees to also be knowledgeable on chemical safety and appropriate working procedures in an effort to reduce and eliminate chemical exposures to themselves, as well as the other craftsmen.

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APPENDIX C

COMMON MSDS TERMS

Absolute	A chemical substance that is not mixed; pure. An example is Absolute Alcohol, which is ethyl alcohol containing not more than one percent by weight of water.
Acute Effect	An adverse effect on a human or animal body, with severe symptoms developing rapidly and coming quickly to a crisis. Also see "chronic".
Acute Toxicity	The adverse (acute) effects resulting from a single dose of or exposure to a substance. Ordinarily used to denote effects in experimental animals.
ACGIH	American Conference of Governmental Industrial Hygienists; an organization of professional personnel in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH develops and publishes recommended occupational exposure limits (see TLV) for hundreds of chemical substances and physical agents.
ANSI	American National Standards Institute; a privately funded, voluntary membership organization that identifies industrial and public needs for national standards and coordinates development for such standards. Many ANSI standards relate to safe design/performance of equipment, such as safety shoes; eyeglasses; smoke detectors; fire pumps; household appliances; and safe practices or procedures such as noise measurement; testing of fire extinguishers and flame arrestors; industrial lighting practices; use of abrasive wheels.
API	American Petroleum Institute; voluntary membership organization of the petroleum industry. Among its services, API assists member committees in developing, processing, and publishing recommended practices for drilling and well servicing, storage tank installation, tank cleaning, piping and fittings, other industry-related design, installation and operating practices; also funds and publishes basic reference books and manuals (example: "Industrial Hygiene Monitoring Manual for Petroleum Refineries and Selected Petrochemical Operations").

Asphyxiant	A vapor or gas which can cause unconsciousness or death by suffocation (lack of oxygen). Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in the air (normally about 21%) to dangerous levels (19.5% or lower). Asphyxiation is one of the principal potential hazards of working in confined spaces.
ASTM	American Society for Testing and Materials; voluntary membership organization with members from a broad spectrum of individuals, agencies, and industries concerned with materials. The world's largest source of voluntary standards for materials, products, systems and services, ASTM is a resource for sampling and testing methods, health and safety aspects of materials, safe performance guidelines, effects of physical and biological agents and chemicals.
Boiling Point	The temperature at which a liquid changes to a vapor state, at a given pressure; usually expressed in degrees Fahrenheit at sea level pressure (760 mmHg, or one atmosphere). For mixtures, the initial boiling point or the boiling range may be given. Flammable materials with low boiling points generally present special fire hazards. Some approximate boiling points:

Propane	-44° F
Anhydrous Ammonia	-28° F
Butane	31° F
Gasoline	100° F
Allyl Chloride	113° F
Ethylene Glycol	387° F

BOM, or BuMines	Bureau of Mines of the U.S. Department of Interior. The Bureau of Mines began approving air breathing apparatus in 1918, later added all types of respirators. BOM's respirator testing/approval activities have been discontinued; NIOSH now has this responsibility. BOM-approved Type 14F gas masks are still acceptable; all other BOM approvals have expired or been replaced by NIOSH approvals.
"C", or Ceiling	The maximum allowable human exposure limit for an airborne substance; not to be exceeded even momentarily. Also see "PEL" and "TLV".
CAA	Clean Air Act; Federal law enacted to regulate/reduce air pollution. Administered by EPA.
Carcinogen	A substance or agent capable of causing or producing cancer in mammals.

C.A.S.	Chemical Abstracts Service; A Columbus, Ohio organization which indexes information published in "Chemical Abstracts" by the American Chemical Society and provides index guides by which information about particular substances may be located in the "Abstracts" when needed. "C.A.S. Numbers" identify specific chemicals.
cc	Cubic centimeter; a volume measurement in a metric system, equal in capacity to one milliliter (ml). One quart is about 946 cubic centimeters.
Chemical Family	A group of single elements or compounds with a common general name. Examples: acetone, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK) are of the "ketone" family; acrolein, furfural, and acetaldehyde are of the "aldehyde" family.
CHEMTREC	Chemical Transportation Emergency Center is a national center established by the Chemical Manufacturers Association (CMA) in Washington, DC in 1970; to relay pertinent emergency information concerning specific chemicals on request. CHEMTREC has a 24-hour toll free telephone number (800-424-9300), intended primarily for use by those who respond to chemical transportation emergencies.
Chronic Effect	An adverse effect on a human or animal body, with symptoms which develop slowly over a long period of time or which recur frequently. Also see "acute".
Chronic Toxicity	Adverse (chronic) effects resulting from repeated doses of, or exposures to a substance over a relatively prolonged period of time. Ordinarily used to denote effects in experimental animals.
CWA	Clean Water Act; Federal law enacted to regulate/reduce water pollution. Administered by EPA.
CO	Carbon monoxide, a colorless, odorless, flammable and very toxic gas produced by the incomplete combustion of carbon; also a by-product of many chemical processes.
CO_2	Carbon dioxide - a heavy, colorless gas, produced by the combustion and decomposition of organic substances and as a by-product of many chemical processes. CO_2 will not burn and is relatively non-toxic (although high concentrations, especially in confined spaces, can create hazardous oxygen-deficient environments).
COC	Cleveland Open Cup; a flash point test method.

Combustible	A term used by NFPA, DOT, and others to classify certain liquids that will burn, on the basis of flash points. Both NFPA and DOT generally define "combustible liquids" as having a flash point of 100° F (37.8° C) or higher. Also, see "flammable". Non-liquid substances such as wood and paper are classified as "ordinary combustibles" by NFPA.
Concentration	The relative amount of a substance when combined or mixed with other substances. Examples: 2 ppm hydrogen sulfide in air, or a 50 percent caustic solution.
Corrosive	As defined by DOT, a corrosive material is a liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact or -- in the case of leakage from its packaging -- a liquid that has a severe corrosion rate on steel. A solid or liquid waste which exhibits a "characteristic of corrosiveness", as defined by RCRA, may be regulated (by EPA) as a hazardous waste.
CPSC	Consumer Products Safety Commission; Federal agency with responsibility for regulating hazardous materials when they appear in consumer goods. For CPSC purposes, hazards are defined in the Hazardous Substances Act and the Poison Prevention Packaging Act of 1970.
Cutaneous Toxicity	See "Dermal Toxicity".
Decomposition	Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into parts or elements or simpler compounds.
Dermal	Used on or applied to the skin.
Dermal Toxicity	Adverse effects resulting from skin exposure to a substance. Ordinarily used to denote effects in experimental animals.
DHHS	U.S. Department of Health and Human Services; created in 1980 to replace the Department of Health, Education, and Welfare (DHEW) as "parent" for NIOSH, Public Health Service, and other agencies related to health and safety.
DOL	U.S. Department of Labor; includes the Occupational Safety and Health Administration (OSHA).

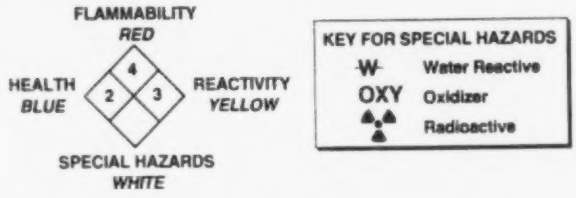
DOT	U.S. Department of Transportation; regulates transportation of chemicals and other substances, to aid in the protection of the public as well as fire, law enforcement, and other emergency response personnel, particularly when transportation incidents occur involving hazardous materials. Detailed DOT classification lists specify appropriate warnings -- such as Oxidizing Agent or Flammable Liquid -- which must be used for various substances.
EPA	U.S. Environmental Protection Agency; Federal agency with environmental protection regulatory and enforcement authority. Administers Clean Air Act, Clean Water Act, FIFRA, RCRA, TSCA, other Federal environmental laws.
Epidemiology	The science which deals with the study of disease in a general population. Determination of the incidence (rate of occurrence) and distribution of a particular disease (as by age, sex, or occupation) may provide information about the causes of the disease.
Evaporation Rate	The rate at which a particular material will vaporize (evaporate) when compared to the rate of vaporization of a known material. The evaporation rate can be useful in evaluating the health and fire hazards of a material. The known material is usually normal butyl acetate (NBUAC or n-BuAc), with a vaporization rate designated as 1.0. Vaporization rates of other solvents or materials are then classified as: • **FAST** evaporating if greater than 3.0. Examples: Methyl Ethyl Ketone (MEK) = 3.8, Acetone = 5.6, Hexane = 8.3. • **MEDIUM** evaporating if 0.8 to 3.0 Examples: 190 proof (95%) Ethyl Alcohol = 1.4, VM&P Naphtha = 1.4, MIBK = 1.6. • **SLOW** evaporating if less than 0.8. Examples: Xylene = 0.6, Isobutyl Alcohol = 0.6, Normal Butyl Alcohol = 0.4, Water = 0.3, Mineral Spirits = 0.1.
FDA	The U.S. Food and Drug Administration; under the provisions of the Federal Food, Drug, and Cosmetic Act, the FDA establishes requirements for the labeling of foods and drugs to protect consumers from misbranded, unwholesome, ineffective, and hazardous products. FDA also regulates materials for food contact service and the conditions under which such materials are approved.
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act; regulations administered by EPA under this Act require that certain useful poisons, such as chemical pesticides, sold to the public contain labels that carry health hazard warnings to protect users.

Flash Point	The temperature at which a liquid will give off enough flammable vapor to ignite. There are several flash point test methods, and flash points may vary for the same material depending on the method used, so the test method is indicated when the flash point is given (150° PMCC, 200° TCC, etc.).
Flammable	A "flammable liquid" is defined by NFPA and DOT as a liquid with a flash point below 100° F (37.8° C). Solids which will ignite readily or are liable to cause fires under ordinary conditions of transportation through friction or retained heat from manufacturing or processing, and which burn so vigorously and persistently as to create a serious transportation hazard, are classified by DOT as "flammable solids". Also see "combustible".
Formula	The conventional scientific designation for a material (water is H_20, sulfuric acid is H_2SO_4, sulfur dioxide is SO_2, etc.).
General Exhaust	A system for exhausting air containing contaminants from a general work area. Also see "local exhaust".
g	Gram; a metric unit of weight. One ounce U.S. (avoirdupois) is about 28.4 grams.
g/kg	Grams per kilograms; an expression of dose used in oral and dermal toxicology testing to indicate the grams of substance dosed per kilogram of animal body weight. Also see "kg" (kilogram).
Hazardous Material	In a broad sense, a hazardous material is any substance or mixture of substances having properties capable of producing adverse effects on the health or safety of a human. In 1971, the Occupational Safety and Health Administration (OSHA) adopted the following definition in regulations affecting employers in operations subject to the Federal Longshoremen's and Harbor Workers' Compensation Act: "The term hazardous material means a material which has one or more of the following characteristics: 1. Has a flashpoint below 140° F., closed cup, or is subject to spontaneous heating. 2. Has a threshold limit value below 500 ppm for gases and vapors, below 500 MG/m^3 for fumes, and below 25 mppcf for dusts. 3. A single dose oral LD_{50} below 500 mg/kg. 4. Is subject to polymerization with the release of large amounts of energy. 5. Is a strong oxidizing or reducing agent. 6. Causes first degree burns to skin in short time exposure, or is systemically toxic by skin contact. 7. In the course of normal operations, may produce dusts, gases, fumes, vapors, mists, or smokes which have one or more of the above characteristics."

Ignitable	Capable of being set afire.
Incompatible	Materials which could cause dangerous reactions from direct contact with one another are described as incompatible.
Ingestion	The taking in of a substance through the mouth.
Inhalation	The breathing in of a substance in the form of a gas, vapor, fume, mist, or dust.
Inhibitor	A chemical which is added to another substance to prevent an unwanted chemical change from occurring.
Irritant	A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin, or respiratory system. The contact may be a single exposure or multiple exposures. Some primary irritants: chromic acid, nitric acid, sodium hydroxide, calcium chloride, amines, metallic salts, chlorinated hydrocarbons, ketones, alcohols.
Irritating	An irritating material, as defined by DOT, is a liquid or solid substance which, upon contact with fire or when exposed to air, gives off dangerous or intensely irritating fumes (not including poisonous materials; see Poison, Class A and Poison, Class B).
kg	Kilogram; a metric unit of weight, about 2.2 U.S. pounds. Also see "g/kg", "g", and "mg".
L	Liter; a metric unit of capacity. A U.S. quart is about 9/10 of a liter.
LC	Lethal concentration; a concentration of a substance being tested which will kill a test animal.
LC_{50}	Lethal concentration 50; the concentration of a material in air which, on the basis of laboratory tests, is expected to kill 50% of a group of test animals when administered as a single exposure (usually 1 or 4 hours). The LC_{50} is expressed as parts of material per million parts of air, by volume (ppm) for gases and vapors, or as micrograms of material per liter of air (µg/L) or milligrams of material per cubic meter of air (mg/m^3) for dusts and mists, as well as for gases and vapors.
LD	Lethal dose; a concentration of a substance being tested which will kill a test animal.

LD_{50}	Lethal dose$_{50}$; a single dose of a material which on the basis of laboratory tests is expected to kill 50% of a group of test animals. The LD_{50} dose is usually expressed as milligrams or grams of material per kilogram of animal body weight (mg/kg or g/kg).
LEL, or LFL	Lower explosive limit or lower flammable limit of a vapor or gas; the lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At concentrations lower than the LEL, the mixture is too "lean" to burn. Also see "UEL".
Local Exhaust	A system for capturing and exhausting contaminants from the air at the point where the contaminants are produced (welding, grinding, sanding, other processes or operations). Also see "general exhaust".
m^3	Cubic meter; a metric measure of volume, about 35.3 cubic feet or 1.3 cubic yards.
Melting Point	The temperature at which a solid substance changes to a liquid state. For mixtures, the melting range may be given.
Mechanical Exhaust	A powered device, such as a motor-driven fan or air/stream venturi tube, for exhausting contaminants from a workplace, vessel, or enclosure.
mg	Milligram; a metric unit of weight. There are 1,000 milligrams in one gram (g) of a substance.
mg/kg	Milligrams per kilogram; an expression of toxicological dose. See "g/kg".
mg/m^3	Milligrams per cubic meter; a unit for measuring concentrations of dusts, gases, or mists in air.
mL	Milliliter; a metric unit of capacity, equal in volume to one cubic centimeter (cc), or about 1/16 of a cubic inch. There are 1,000 milliliters in one liter (L).
mmHg	Millimeters (mm) of mercury (Hg); a unit of measurement for low pressures or partial vacuums.
mppcf	Million particles per cubic foot; a unit for measuring particles of a substance suspended in air. Exposure limits for mineral dusts (silica, graphite, Portland cement, nuisance dusts, and others), formerly expressed as mppcf, are now more commonly quoted in mg/m^3.

MSHA	The Mining Safety and Health Administration of the U.S. Department of the Interior; Federal agency with safety and health regulatory and enforcement authorities for the mining industry. Also see "OSHA".
Mutagen	A substance or agent capable of altering the genetic material in a living cell.
NaOH	Sodium hydroxide, or caustic soda.
N_2	Nitrogen; a colorless, odorless, and tasteless gas that will not burn and will not support combustion. The earth's atmosphere (air) is about 78% nitrogen; at higher concentrations, nitrogen can displace oxygen and become a lethal asphyxiant. See "Asphyxiant".
NRC	National Response Center; a notification center in the Coast Guard Building in Washington, DC, U.S., with a toll free telephone number (1-800-424-8802) which must be called when significant oil or chemical spills or other environmentally related accidents occur.
NBUAC, or n-BuAc	Normal butyl acetate. See "evaporation rate".
NFPA	National Fire Protection Association; an international voluntary membership organization to promote/improve fire protection and prevention and establish safeguards against loss of life and property by fire. Best known on the industrial scene for the National Fire Codes - 16 volumes of codes, standards, recommended practices, and manuals developed (and periodically updated) by NFPA technical committees. Among these is NFPA 704M, the code for showing hazards of materials using the familiar diamond-shaped label or placard with appropriate numbers or symbols. The brief explanation below illustrates the NFPA principle of using scales of 0 to 4 (low to high) to classify material hazards:



Fire Hazard (Red)

4 - Burns readily at ambient conditions
3 - Will ignite at most ambient conditions
2 - Will ignite if moderately heated
1 - Will ignite if preheated
0 - Will not burn

Health Hazard (Blue)

4 - Deadly
3 - Extreme danger
2 - Hazardous
1 - Slightly hazardous
0 - Ordinary combustible hazards in a fire

Reactivity (Yellow)

4 - May detonate
3 - Shock and heat may detonate
2 - Violent Chemical change
1 - Unstable if heated
0 - Stable and not reactive with water

Specific Hazard

OXY	Oxidizer
ACID	Acid
ALKALI	Alkali
COR	Corrosive
-W-	Use No Water
	Radiation Hazard

NIOSH	National Institute for Occupational Safety and Health of the Public Health Service, U.S. Department of Health and Human Services (DHHS); Federal agency which - among other activities - tests and certifies respiratory protective devices and air sampling detector tubes, recommends occupational exposure limits for various substances and assists OSHA and MSHA in occupational safety and health investigations and research.
NO_x	Oxides of nitrogen; undesirable air pollutants. NO_x emissions are regulated by EPA under the Clean Air Act.
Olfactory	Relating to the sense of smell. The olfactory organ in the nasal cavity is the sensing element that detects odors and transmits information to the brain through the olfactory nerves.
Oral	Used in or taken into the body through the mouth.
Oral Toxicity	Adverse effects resulting from taking a substance into the body via the mouth. Ordinarily used to denote effects in experimental animals.
OSHA	Occupational Safety and Health Administration of the U.S. Department of Labor; Federal agency with safety and health regulatory and enforcement authorities for most U.S. industry and business. Also see "MSHA".

Oxidation	In a literal sense, oxidation is a reaction in which a substance combines with oxygen provided by an oxidizer or oxidizing agent (see definitions below). In a broader sense, based on modern atomic theory, science today defines oxidation as a reaction - brought about by an oxidizing agent - in which atoms, molecules, or ions lose electrons. In this broader sense, an oxidation reaction may occur even when oxygen is not present. However it may be defined, an oxidation reaction is always accompanied by an offsetting (balancing) reduction reaction in which (1) oxygen is removed from a compound, or (2) atoms, molecules, or ions gain electrons.
Oxidizer	DOT defines an oxidizer or oxidizing material as a substance which yields oxygen readily to stimulate the combustion (oxidation) of organic matter. Chlorate ($Cl0_3$), permanganate (MnO_4), and nitrate (NO_3) compounds are examples of oxidizers; note that all contain oxygen (O).
Oxidizing Agent	A chemical or substance which brings about an oxidation reaction. The agent may (1) provide the oxygen to the substance being oxidized (in which case the agent has to be oxygen, or contain oxygen), or (2) it may receive electrons being transferred from the substance undergoing oxidation (chlorine is a good oxidizing agent for electron-transfer purposes, even though it contains no oxygen).
PEL	Permissible exposure limit; an exposure limit established by OSHA regulatory authority. May be a time-weighted average (TWA) limit or a maximum concentration exposure limit. Also see "Skin".
% Volatile	Percent volatile by volume; the percentage of a liquid or solid (by volume) that will evaporate at an ambient temperature of 70° F (unless some other temperature is stated). Examples: butane, gasoline, and paint thinner (mineral spirits) are 100% volatile; their individual evaporation rates vary, but over a period of time each will evaporate completely.
PMCC	Pensky-Martens Closed Cup; a flash point test method.
Poison, Class A	A DOT term for extremely dangerous poisons, that is, poisonous gases or liquids of such nature that a very small amount of the gas, or vapor of the liquid, mixed with air is dangerous to life. Some examples: phosgene, cyanogen, hydrocyanic acid, nitrogen peroxide.
Poison, Class B	A DOT term for liquid, solid, paste, or semi-solid substances - other than Class A poisons or irritating materials - which are known (or presumed on the basis of animal tests) to be so toxic to man as to afford a hazard to health during transportation.

Polymerization	A chemical reaction in which one or more small molecules combine to form larger molecules. A hazardous polymerization is such a reaction which takes place at a rate which releases large amounts of energy. If hazardous polymerization can occur with a given material, the MSDS usually will list conditions which could start the reaction; and since the material usually contains a polymerization inhibitor, the expected time period before the inhibitor is used up.
ppm	Parts per million; a unit for measuring the concentration of a gas or vapor in air - parts (by volume) of the gas or vapor in a million parts of air. Also used to indicate the concentration of a particular substance in a liquid or solid.
ppb	Parts per billion; a unit for measuring the concentration of a gas or vapor in air - parts (by volume) of the gas or vapor in a billion parts of air. Usually used to express measurements of extremely low concentrations of unusually toxic gases or vapors. Also used to indicate the concentration of a particular substance in a liquid or solid.
psi	Pounds per square inch; for MSDS purposes, a unit for measuring the pressure a material exerts on the walls of a confining vessel or enclosure. For technical accuracy, pressure must be expressed as psig (pounds per square inch gauge) or psia (pounds per square inch absolute; that is gauge pressure plus sea level atmospheric pressure, of psig plus about 14.7 pounds per square inch). Also see "mmHg".
Reaction	A chemical transformation or change; the interaction of two or more substances to form new substances.
Reactivity	A description of the tendency of a substance to undergo chemical reaction with the release of energy. Undesirable effects - such as pressure buildup, temperature increase, formation of noxious, toxic, or corrosive by-products - may occur because of the reactivity of a substance to heating, burning, direct contact with other materials or other conditions in use or in storage. A solid waste which exhibits a "characteristic of reactivity", as defined by RCRA, may be regulated (by EPA) as a hazardous waste.
Reducing Agent	In a reduction reaction (which always occurs simultaneously with an oxidation reaction) the reducing agent is the chemical or substance which (1) combines with oxygen, or (2) loses electrons to the reaction. See "oxidation".

Respiratory System The breathing system; includes the lungs and air passages (trachea or "windpipe", larynx, mouth, and nose) to the air outside the body, plus the associated nervous and circulatory supply.

RCRA Resource Conservation and Recovery Act; Federal environmental legislation, administered by EPA, aimed at controlling the generation, treating, storage, transportation, and disposal of hazardous wastes.

Sensitizer A substance which on first exposure causes little or no reaction in man or test animals, but which on repeated exposure may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form of sensitization in the industrial setting, although respiratory sensitization to a few chemicals is also known to occur.

SETA Setaflash Closed Tester; a flash point test method.

"Skin" A notation, sometimes used with PEL or TLV exposure data; indicated that the stated substance may be absorbed by the skin, mucous membranes, and eyes - either airborne or by direct contact - and that this additional exposure must be considered part of the total exposure to avoid exceeding the PEL or TLV for that substance.

Skin Sensitizer See "Sensitizer".

Skin Toxicity See "Dermal Toxicity".

Solubility in Water A term expressing the percentage of a material (by weight) that will dissolve in water at ambient temperature. Solubility information can be useful in determining spill cleanup methods and fire-extinguishing agents and methods for a material. Terms used to express solubility are:

negligible	less than 0.1 percent
slight	0.1 to 1.0 percent
moderate	1 to 10 percent
appreciable	more than 10 percent
complete	soluble in all proportions

SO_x Oxides of sulfur; undesirable air pollutants. SO_x emissions are regulated by EPA under the Clean Air Act.

Species A biological type; on MSDS's, species refer to the test animals - usually rats, mice, or rabbits - which were used to obtain the toxicity test data reported.

Specific Gravity	The weight of a material compared to the weight of an equal volume of water; an expression of the density (or heaviness) of the material. Example: if a volume of a material weighs 8 pounds, and an equal volume of water weighs 10 pounds, the material is said to have a specific gravity of 0.8. $\frac{8\text{ lbs}}{10\text{ lbs}} = 0.8$ Insoluble materials with specific gravity of less than 1.0 will float in (or on) water. Insoluble materials with specific gravity greater than 1.0 will sink (or go to the bottom) in water. Most (but not all) flammable liquids have specific gravity less than 1.0 and, if not soluble, will float on water - an important consideration for fire suppression and spill clean-up.
Stability	An expression of the ability of a material to remain unchanged. For MSDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage or use. Conditions which may cause instability (dangerous change) are stated - examples, temperatures about 150° F, shock from dropping.
STEL	Short term exposure limit; ACGIH terminology. See "TLV-STEL".
Synonym	Another name or names by which a material is known. Methyl alcohol, for example, is also known as methanol, or wood alcohol.
TCC	Tag (Tagliabue) Closed Cup; a flash point test method.
Teratogen	A substance or agent to which exposure of a pregnant female can result in malformations in the fetus.
TLV	Threshold Limit Value; a term used by ACGIH to express the airborne concentration of a material to which nearly all persons can be exposed day after day, without adverse effects. See "Skin" in the glossary relative to TLVs. ACGIH expresses TLVs in three ways: • **TLV-TWA**: The allowable Time Weighted Average concentration for a normal 8-hour work day or 40-hour work week. • **TLV-STEL**: The Short-Term Exposure Limit, or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods, and provided that the daily TLV-TWA is not exceeded). • **TLV-C**: The Ceiling exposure limit - the concentration that should not be exceeded even instantaneously.

TOC	TAG Open Cup; a flash point test method.
Toxicity	The sum of adverse effects resulting from exposure to a material, generally by the mouth, skin, or respiratory tract. For RCRA purposes, solid or liquid wastes which exhibit certain specified "characteristics of toxicity" may be regulated by EPA as hazardous wastes.
Trade Name	The trademark name or commercial trade name for a material.
TSCA	Toxic Substance Control Act; Federal environmental legislation, administered by EPA, for regulating the manufacture, handling, and use of materials classified as "toxic substances".
TWA	Time Weighted Average exposure; the airborne concentration of a material to which a person is exposed, averaged over the total exposure time, generally the work day (8 to 12 hours). Also see "TLV".
UEL or UFL	Upper explosive limit or upper flammable limit of a vapor or gas; the highest concentration (highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At higher concentrations, the mixture is too "rich" to burn. Also see "LEL".
Unstable	Tending toward decomposition or other unwanted chemical change during normal handling or storage.
USDA	U.S. Department of Agriculture; prior to 1971, USDA performed tests and issued approvals on respirators for use with pesticides. In 1971, the Bureau of Mines took over the pesticide respirator testing/approval functions - procedures later delegated to the Testing and Certification Branch (TCB) of NIOSH. Also see "BOM".
Vapor Density	The weight of a vapor or gas compared to the weight of an equal volume of air; an expression of the density of the vapor or gas. Materials lighter than air have vapor densities less than 1.0 (examples: acetylene, methane, hydrogen). Materials heavier than air (examples: propane, hydrogen sulfide, ethane, butane, chlorine, sulfur dioxide) have vapor densities greater than 1.0. All vapors and gases will mix with air, but the lighter materials will tend to rise and dissipate (unless confined). Heavier vapors and gases are likely to concentrate in low places - along or under floors, in sumps, sewers and manholes, in trenches and ditches - where they may create fire or health hazards.

Vapor Pressure	The pressure exerted by a saturated vapor above its own liquid in a closed container. When quality control tests are performed on products the test temperature is usually 100° F and the vapor pressure is expressed as pounds per square inch (psig or psia) - but vapor pressures reported on MSDS's are in millimeters of mercury (mmHg) at 68° F (20° C), unless stated otherwise. Three facts are important to remember: 1. Vapor pressure of a substance at 100° F will always be higher than the vapor pressure of the substance at 68° F (20° C). 2. Vapor pressures reported on MSDS's in mmHg are usually very low pressures; 760 mmHg is equivalent to 14.7 pounds per square inch. 3. The lower the boiling point of a substance, the higher its vapor pressure.
Ventilation	See "general exhaust", "local exhaust", and "mechanical ventilation".

FIRE EXTINGUISHING

Classification of Fires

Class A Fires

Class A fires occur in ordinary combustible materials such as wood, cloth, paper, rubber, and most plastics. The most commonly used extinguishing agent is water, which cools and quenches. Fire in Class A materials can also be extinguished by dry chemical used on ABC fires, which break up the chemical chain reaction.

Class B Fires

Class B fires are fires involving flammable liquids, oil, greases, tars, paints, and flammable gases. Dry chemical, foam, vaporizing liquids, and carbon dioxide can be used on this type of fire. Water fog can be used as an extinguishing agent depending on the circumstances of the fire.

Class C Fires

Class C fires involve energized electrical equipment where non-conducting extinguishing agents must be used. Dry chemical of carbon dioxide are used. The use of water can kill or injure the person fighting the fire because it conducts electricity.

Class D Fires

Class D fires are fires in combustible metals, such as magnesium, titanium, and potassium. Metal X is used because a chemical chain reaction will occur if normal extinguishing agents are used. ONLY specialized extinguishing agents should be used.

Portable Fire Extinguishers

Portable fire extinguishers are intended as a first line of defense to cope with fires of limited size. For a fire extinguisher to be of any value or effectiveness four things must exist:

1. The fire extinguisher must be properly located and in working condition.
2. The fire extinguisher must be the class suitable for the type of fire on which it is to be used.
3. The fire must be discovered by a person who is ready, willing, and able to properly use the extinguisher.
4. The fire must be discovered in its early stages.

Fire Extinguisher Ratings

Class A

Class A extinguishers have a number rating. The number is the amount of fire that can be extinguished with 1 1/4 gallons of water. A Class 2A extinguisher would be the amount of fire that can be extinguished by 2 1/2 gallons of water.

Class B

Class B also has a number rating meaning the square foot surface area it will cover. A 16B extinguisher will be able to extinguish a 4 x 4 foot area of burning area.

Class C

This means that the material in this extinguisher is a non-conductor of electricity.

Class D

The material in this extinguisher can be used on certain types of metal fires.

Types of Extinguishers

Liquid Type

1. Water Extinguisher - Stored Pressure

   - Size 2 1/2 gallon
   - Used on Class A fires
   - Stream reaches about 30 - 40 feet
   - Discharge time about 1 minute
   - Propellant is compressed air

   Conditions: Protect from freezing

2. AFFF - Light Water

   - Size 2 1/2 gallon
   - Used on Class A and B fires
   - Stream reaches about 30 - 40 feet
   - Discharge time about 1 minute

   Conditions: Protect from freezing

Gas Type

1. Carbon Dioxide

   - Size 2 - 20 pounds
   - Used on Class B and C fires
   - Stream reach of about 3 - 8 feet
   - Discharge time about 15 - 30 seconds
   - CO_2 is stored at a high pressure of 800 -900 psi at 70° F. At 120° it will be about 2, 500 psi.
   - Relief valve goes off about 2, 700 psi
   - Full weight and empty weight stamped into head for purposes of weighting (10% low must be refilled)

   Conditions:

   - Protect from freezing
   - Maximum storage temperature 130° F
   - Can be an ignition source due to static electricity at the horn
   - Can cause frost bite

2. Halon - Stored Pressure

   - Sizes - various
   - Smaller size used on Class B and C fires
   - Larger sizes used on ABC fires
   - Reach of 9 - 15 feet
   - Discharge time 15 - 30 seconds
   - Stored in cylinders
   - Halon interrupts chemical chain reaction to extinguish a fire
   - Clean and non-corrosive
   - Same UL listing as CO_2
   - Is pressurized by nitrogen
   - Is non-toxic in the quantities used for putting out fires
   - Has built in warning of toxicity - an unbearable odor

Solid Type

1. Dry Chemical

   - Sizes 1 1/2 - 30 pounds
   - Used on Class B and C fires - also type ABC fires if applicable
   - Reach of 5 - 20 feet
   - Discharge time 10 - 15 seconds
   - Will not freeze
   - Extinguishes fire by disrupting chemical chain reaction
   - Pressurized - usually with nitrogen
   - Pressures vary from 175 - 350 psi

   Conditions:

   - Once used valve assembly must be cleaned and extinguisher refilled.

2. Cartridge Type - Dry Chemical
    - Sizes 2 1/2 - 30 pounds
    - Used on Class B and C fires, unless rated ABC
    - Reach of 5 - 20 feet
    - Discharge time 15 - 25 seconds
    - Does not need protection from freezing
    - Extinguishes fire by disrupting chemical chain reaction
    - Cartridges usually pressurized by CO_2 or nitrogen
    - Pressure in cartridges usually between 800 - 900 psi
    - CO_2 cartridges have left hand threads; nitrogen have right hand threads

Fire Extinguisher Inspection/Maintenance/ Recharging

Inspection

Fire extinguisher inspection is a "quick check" that an extinguisher is available and will operate. It is intended to give reasonable assurance that the extinguisher is fully charged and operable.

Frequency

Extinguishers shall be inspected when initially placed in service or after a 30 day interval. Extinguishers must also have an annual inspection regardless of whether it has been placed in service or not.

Procedure

Periodic inspection of extinguishers shall include a check of at least the following items.

a. Operating instructions on name plate are legible.
b. Seals and tamper indicators are not broken or missing
c. Determine fullness by weighing of hefting.
d. Examine for obvious physical damage, corrosion, leakage, or clogged nozzle.
e. Pressure gauge reading or indicator in the operable range or position.

Maintenance

Maintenance is a thorough examination of the extinguisher. It is intended to give maximum assurance that an extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair or replacement. It will normally reveal if hydrostatic testing is required.

Procedure

Maintenance cannot be done in the tool crib. The extinguisher must be sent out to a company with properly qualified service personnel and parts.

Maintenance procedures should include a thorough examination of the three basic elements of an extinguisher:

1. mechanical parts;
2. extinguishing agent; and,
3. expelling means

NOTE: During annual maintenance it is not necessary to internally examine non-rechargeable or stored pressure extinguishers.

Recharging

Recharging is the replacement of the extinguishing agent and also includes the expellent for certain types of fire extinguishers.

Frequency

Recharging is done when an extinguisher has been used or when a hydrostatic test has been conducted.

Procedure

Recharging cannot be done in the tool crib. The extinguisher must be sent out to a company with properly qualified service personnel and equipment.

Hydrostatic Testing Intervals

Hydrostatic testing should be performed by persons trained in pressure testing procedures and having available testing equipment, facilities, and appropriate servicing manuals.

If at any time an extinguisher shows evidence of corrosion or mechanical injury it shall be hydrostatically tested.

5-1.3 Examination of Cylinder Condition. When an extinguisher cylinder or shell has one or more conditions listed in this subdivision, it shall not be hydrostatically tested, but shall be destroyed by the owner or at his or her direction:

(a) When there exist repairs by soldering, welding, brazing, or use of patching compounds.

NOTE: For welding or brazing on mild steel shells, consult the manufacturer of this extinguisher.

(b) When the cylinder or shell threads are damaged.

(c) When there exists corrosion that has caused pitting, including under removable nameplate band assemblies.

(d) When the extinguisher has been burned in a fire.

(e) When a calcium chloride type of extinguishing agent was used in a stainless steel extinguisher.

(f) When the shell is of copper or brass construction joined by soft solder or rivets.

(g) All inverting-type extinguishers.

Sources: NFPA 10 Portable Fire Extinguishers 1990 Edition

Hydrostatic Test Intervals for Extinguishers

Extinguisher Type	Test Interval (Years)
Soda-Acid	Note 1
Cartridge-Operated Water and/or Antifreeze	Note 1
Stored Pressure Water Loaded Stream, and/or Antifreeze	5
Wetting Agent	5
Foam	Note 1
AFFF (Aqueous File Forming Foam)	5
FFFP (Film Forming Flouroprotein Foam)	5
Dry Chemical with Stainless Steel Shells	5
Carbon Dioxide	5
Dry Chemical, Stored Pressure, with Mild Steel Shells, Brazed Brass Shells, or Aluminum Shells	12
Halogenated Agents	12
Dry Powder, Stored Pressure, Cartridge- or Cylinder-Operated, with Mild Steel Shells	12

Sources: NFPA 10 Portable Fire Extinguishers 1990 Edition

NOTE: Extinguishers with copper or brass shells joined by soft solder were prohibited from further hydrostatic testing effective May 18, 1978. Extinguishers with stainless steel or brazed brass shells that were permitted to remain in service had had a five-year hydrostatic test interval. Effective December 22, 1987, when the hydrostatic test date arrives, all types of inverting extinguishers shall not be tested by removed from service.

Record Keeping

Each extinguisher shall have a tag securely attached that indicates the month and year the inspection, maintenance, and recharging was performed and the initials of the person who performed the service.

In addition to the required tag, a permanent record log should be kept on all extinguishers. This record log should include the following information as applicable:

1. The inspection date and name of the person performing the maintenance.
2. The date when last recharged and name of the person performing the recharge.
3. The hydrostatic retest date and the name of the agency performing the hydrostatic test.
4. Description of dents remaining after passing a hydrostatic test.

Types of Dry Chemical

Regular Dry -Chemical (Sodium Bicarbonate Based)-

- Agents whose base is bicarbonate
- Rated for Class B and C fires

The common name for the sodium bicarbonate based extinguisher is Standard or Plus Fifty C. It is the most widely used dry chemical. The bluish-white color differentiates this powder from other types.
Standard extinguishers may be used to combat Class B fires (flammable liquids), or energized electrical equipment (Class C). The powder is free-flowing, non-abrasive, and will not produce a toxic effect when used as a fire fighting agent.

NEVER mix Standard with phosphate based dry chemicals (ABC). A chemical reaction will result that will cause damage to the extinguisher. Following discharge, these extinguishers are to be filled ONLY with the original type of agent as specified on the name plate.

ABC Multipurpose Dry Chemical (Monoammonium Phosphate Dry Chemical)

- Agents whose base is monoammonium phosphate
- Rated for Class A, B, and C fires

The common name for this product is A.B.C. or Foray. A.B.C. or Multipurpose can be used on Class A, B, and C fires. The color yellow makes the product easy to identify. ABC is a free-flowing water repellent, non-abrasive, and when used as a firefighting agent will not produce the toxic effects. Moisture may combine with the agent in a post fire situation to produce a mild corrosion. For this reason, prompt clean up is recommended. If it cannot be swept up quickly, warm water may be used as a solvent.

NEVER mix ABC with any other dry chemical, as a chain reaction will take place causing damage to the extinguisher

Purple K (Potassium Carbonate)

- Rated for Class B and C fires

The common name for this agent is Purple K. Purple K is one of the most effective agents against Class B fires. It is easy to identify because the name of the product is the same as the color.
NEVER mix Purple K with monoammonium phosphate based dry chemical. A chain reaction will take place causing damage to the extinguisher.

Things to Know About Dry Chemical

1. Different chemicals should not be mixed (may cause a chemical chain reaction and develop exceeded pressures).
2. Chemicals presently used are said to be non-toxic.
3. Upper storage temperature should not exceed 140°F. Additives may melt above this temperature.
4. Dry chemicals should not be used where delicate electrical contacts are located.
5. Dry chemicals will not extinguish fires in materials that produce their own oxygen.

Types of Dry Powder

Dry powder is used on Class D fires and essentially what you are doing when using this type of extinguishment is burying the metal.

- Graphite - powder or metal guard
- Sodium Chloride - MET-L-X
- Sand - with scoop

Things to Know About Dry Powder and Class D Fires

1. Use according to directions on extinguisher and only on types of metals specified.

2. NEVER put water on a Class D fire.

Inspection

Stored Pressure Water Extinguishers

1. Check extinguisher body for damage (dents, pit marks). If dents of 1/16" are found, the extinguisher must be hydrostatically tested.

2. Operating instructions on name plate are legible and on front of extinguisher.

3. Check seal and tamper indicators.

4. Check condition of handle and operating lever for damage.

5. Check that hose and nozzle are in good condition and are securely tightened.

6. Determine fullness of extinguisher by weighing or hefting. Do not trust the pressure gauge or indicator for it could be faulty or inaccurate.

7. Sign and date inspection tag.

Carbon Dioxide Extinguishers

1. Check extinguisher body for damage (dents, pit marks). If dents of 1/16" are found the extinguisher must be hydrostatically tested.

2. Operating instructions on name plate are legible and on front of extinguisher.

3. Check seal and tamper indicators.

4. Check condition of handle and operating lever for damage.

5. Check hose for damage and tightness (dry, cracked, or cut).

6. Check horn for condition. (Horn must not be cracked or chipped because static electricity will escape from the horn.)

7. Check pressure release valve for clogging or obstructions.

8. Determine fullness by weighing or hefting.

   Note: CO2 must be weighed quarterly. A loss of more than 10% of the stamped rated weight is an indication that the extinguisher requires recharging.

9. Sign and date the inspection tag.

REVIEW QUIZ

GENERAL CONSTRUCTION - SECTION 4

1. According to OSHA, what is the definition of a confined space? Fill in the blanks.

   Any space having a limited means of ____________________ which

   is subject to the accumulation of ____________________ or

   ____________________ contaminants or has an

   deficient environment.

2. How often should garbage and other waste be disposed? Fill in the blanks.

   Should be disposed of at ____________________ and ____________________

   intervals.

3. A first aid kit shall have supplies in individually sealed packages inside a waterproof container. How often should these contents be checked by the employer?

   a. before the start of each job and at least daily

   b. before the start of each job and at least weekly

   c. before the start of each job and at least monthly

   d. before the start of each job and at least twice a year

4. What type of toilet facilities should be provided on a work site with 20 or less employees?

   a. one toilet

   b. two toilets

   c. one toilet and one urinal

   d. one toilet and two urinals

5. How many decibels can you be exposed to in 15 minutes, per day?

   a. 90

   b. 97

   c. 105

   d. 115

6. The gases, vapors, fumes, dusts and mists standard does not include which of the following?

   a. airborne asbestos

   b. tremolite

   c. anthophyllite

   d. actinolite

   e. all of the above

7. When disposing gases, vapors, fumes, dusts and mists using a ventilation or exhaust system, where should they be discharged?

   a. to an adjacent room or compartment

   b. to the next country

   c. into a special holding tank

   d. to the outside atmosphere

8. What is the recommended eye protection when acetylene cutting?

   a. goggles, spectacles

   b. spectacles, chipping goggles

   c. goggles, face shield, welding helmet

   d. welding goggles

9. What should you do if any lifeline, lanyard, or safety belt has been subjected to in service loading? (A fall has ocurred while the fall equipment was being worn)

   a. removed from service and never used again

   b. inspected and reused

   c. inspected by a site safety inspector and used again only on their recommendation

   d. there is no need for retesting because fall arrest equipment can withstand up to 4,000 pounds of force at any time

10. What is the maximum travel distance from any point of a protected area to the nearest fire extinguisher?

    a. not to exceed 10 feet

    b. not to exceed 100 feet

    c. not to exceed 1000 feet

    d. must be available on the same work site

11. How many fire extinguishers rated not less than 2A, have to be available on a multistory building?

    a. 10

    b. 1 every 4th floor

    c. 1 every 3rd floor

    d. 1 every 2nd floor

    e. 1 every floor

12. When an approved metal cabinet is used to store flammable or combustible materials, how should it be labelled?

    a. "Dangerous, explosive materials"

    b. "Do not enter without authorization"

    c. "Flammable-Keep Away"

    d. "Flammable-Keep Fire Away"

13. What is the color of the flagmens' vest?

    a. red or white

    b. purple or pink

    c. red or orange

    d. green or white

14. How high can masonry blocks be stacked before you must begin to taper them back one half block per tier?

   a. 6 ft
   b. 7 ft
   c. 8 ft
   d. 9 ft

15. Complete this statement. Materials cannot be stored within ________ of a floor opening inside a building under construction.

   a. 2 ft
   b. 3 ft
   c. 4 ft
   d. 5 ft
   e. 6 ft

16. How often is rigging material to be inspected?

   a. before the job begins and weekly thereafter
   b. every second day
   c. rigging material never has to be inspected
   d. prior to use on each shift and as necessary

17. What is the proper way to install a u-bolt on an eye splice?

   a. u-bolt on the dead end
   b. u-bolt on the live end
   c. saddle on the dead end
   d. knot over the eye splice

18. Complete the statement. The use of ____________________ ____________________ for hoisting or lowering tools shall not be permitted.

   a. hoisting buckets
   b. trained operators
   c. experienced signallers
   d. electric cords

19. Which of the following statements about powder actuated tools is false?

    a. only workers who are trained in that particular tool are allowed to operate it

    b. loaded tools cannot be left unattended for any longer than 5 minute intervals

    c. the tool shall be tested each day before loading

    d. a tool that is loaded or empty cannot be pointed at anyone

    e. no fastener can be driven into a spalled area

20. Which of the following rigging statements is true?

    a. cylinders can be hoisted unsecured on a cradle, slingboard or pallet

    b. cylinders should be moved by rolling them on their sides

    c. valve protection caps cannot be used for lifting cylinders from one vertical position to another

    d. regulators must be removed and valve protection caps must be put into place before cylinders are moved in a special carrier

    e. damaged or defective cylinders can be used only in special situations

21. Worn or frayed cords can be used in special situations. For example, when only one concrete vibrator cord is available during a placing job. True or false?

    a. True   b. False

22. Each employer must provide a ladder training program for employees as necessary. True or false?

    a. True   b. False

23. Which of the following would be classified as a class B fire?

    a. wood, cloth, paper, rubber, and most plastics

    b. flammable liquids and gases, oil, grease, tar, and paint

    c. electrical equipment

    d. combustible metal

24. What is the maximum discharge time for a cartridge type, dry chemical fire extinguisher?

a. 10 seconds

b. 15 seconds

c. 20 seconds

d. 25 seconds

25. List 5 inspection procedures for a portable fire extinguisher:

____

____

____

____

____

26. Maintenance on a portable fire extinguisher can only be carried out by qualified service personnel. True of false?

a. True

b. False

27. List 5 things you should know about dry chemicals used in portable fire extinguishers:

____

____

____

____

____

SECTION V(a)
POWER TOOLS - GAS POWERED

Trainee Objectives

Trainees should learn:

1. Operation and maintenance of small gas engines
2. Difference between 2-cycle and 4-cycle engines and types of fuel used.
3. How to correctly operate and sharpen chain saws and operate all-purpose saws.
4. How to correctly operate and maintain mixers, water pumps, generators.
5. How to correctly operate and maintain space heaters.

SECTION V(b)
POWER TOOLS - ELECTRIC

Trainees should learn:

1. Proper use of ground fault interrupters.
2. How to inspect and use extension cords.
3. To correctly operate different electric power tools, to include saws, drills, grinders, rotary hammers, and ventilation equipment.
4. To identify different accessories and their uses for each electric power tool.

SECTION V(c)
POWER TOOLS - PNEUMATIC

Trainees should learn:

1. To demonstrate competency in the operation and maintenance of air compressors.
2. To identify the different air tools, including the attachments and accessories.
3. How to properly prepare, set-up, and operate each type of air tool.
4. To become aware of the safety aspects of each tool.
5. To become aware of the proper use or each air tool.
6. To demonstrate correct use of P.P.E.

7. To demonstrate competency in the use of pavement breakers, jackhammers, chipping guns, pogo sticks, and clay spades.

SECTION V
INSTRUCTOR OUTLINE

Power Tools - Gas Powered

1. Discuss and list equipment on a construction site that may be gas powered. List the following equipment:

   4-cycle:
   1. Mixers
   2. Water pumps
   3. Generators
   4. Compactors - vibrating
   5. Ventilation fans
   6. Space heaters

   2-cycle:
   1. Compactors - rammers
   2. All-purpose saws
   3. Chain saws

2. Show video TIPS AV3 "Small Gas Engines"

3. Discuss all-purpose saws, including uses and types of blades. Show video TIPS AV5 "Portable All-Purpose Saws"

4. Discuss chain saws including maintenance of the cutting bar and chain sharpening. Show videos TIPS AV12 "Safe Chain Saw Operation and Maintenance" and TIPS AV13 "Chain Saw Sharpening". Display chain saw.

5. Discuss fuels and other fluids used in different engines.

6. Discuss safety precautions necessary when working with gas-powered tools and equipment.

7. Discuss space heaters, including LP tanks and salamanders, for heating enclosures during cold weather construction. Point out safety factors dealing with heating enclosures, including set up of heaters and ventilation.

8. Take trainees to equipment storage area and demonstrate each gas powered tool discussed. Show maintenance checks, starting procedures, and operation of these tools.

Power Tools - Electric

1. Discuss extension cords and ground fault interrupters. Show trainees example of GFI and different extension cords.

2. Discuss common electric tools, such as: saws, saber saws, drills, rotary hammers, and grinders. Show video TIPS AV9 "Chipping Guns and Grinders".

3. Discuss electric fans and blowers used for ventilation including confined spaces and ventilation for fumes and vapors.

4. Take trainees to tool storage area and demonstrate use of electric power tools. Show different accessories and their uses. Show how to use GFI and extension cords.

Hands-on for Gas and Electric Power Tools

1. Have trainees practice using each piece of equipment and each tool. Examples for exercises include:
   a. Each exercise should start with maintenance and fluid checks on gas powered equipment and inspection of cords and condition of electric powered tools.
   b. Use all-purpose saw to cut steel such as rebar or other shapes.
   c. Chain saw exercise should include cutting logs or limbs and sharpening the chain after each use.
   d. Set up and operation and water pump and generator.
   e. Set up and operation of LP heater and salamander.
   f. For saws, give trainees demonstration to cut lumber to desired length and for drills give distance from center to center of holes.
   g. Use grinder to clean rusty metal or grind projections on a concrete wall and use rotary hammer to drill and core drill concrete.
2. Be sure that trainees use all required P.P.E. and safe work practices for each exercise.

Power Tools - Pneumatic

1. Begin air tool section with instructions for the use of air compressors to include a safe and thorough routine for checking, servicing, and operating compressors. Refer trainees to Laborers-AGC Training TIPS No. 2 "Compressor: Operation, Maintenance, and Safety".

2. Discuss fluid level checks, transportation, operation, set up at the jobsite, and maintenance procedures for compressors.

3. Talk about air hoses including checks for damage, hose connections, and gaskets. Also discuss the use of line oilers and their location in the line. Discuss freeze protection and antifreeze products.

4. Identify air tools beginning with the 90-pound and 65-pound pavement breakers. Discuss maintenance checks, size and type of tools used, and operation of pavement breakers. Also discuss clay spades. Refer trainees to Laborers-AGC Training TIPS No. 1 "The 90-Pound Pavement Breaker."

5. Next, discuss the jackhammer (refer to Laborers-AGC Training TIPS No. 18 "The Jackhammer") and chipping guns (refer to Training TIPS No. 9 "Chipping Guns and Grinders").

6. Another air tool used in this section is the air compactor or pogo stick. Discuss use of this air tool for backfilling small and narrow openings around footing walls and abutments, etc.

7. Use Laborers-AGC videos to coincide with Training TIPS for each type of air tool discussed in this section.

Hands-On

8. 90# and 65# pavement breakers used to demolish a poured concrete wall, a footing, and a slab or part of a slab.

9. The jackhammer used to drill holes in walls, columns, footings, and slabs.

10. Use the clay spade to make an excavation in hard soil or clay.

11. Use chipping guns to make openings in walls and floors. Use the bush hammer bit to rough up a slab in preparation for repairs and also on walls for decorative finish or design.

12. The pogo stick can be used to backfill a narrow excavation in 4" to 6' lifts.

13. Be sure all air tools are set up and hooked up correctly and safely and make sure all the trainees use the proper P.P.E. for each job.

SECTION Va
SMALL ENGINES

Small gasoline engines are found on construction equipment such as compactors, water pumps, generators, concrete saws, and chain saws. There are 4-cycle (4-stroke) and 2-cycle (2-stroke) gasoline engines. It is very important to be able to distinguish between these two types of engines by looking at them. Two-cycle engines are usually small, lightweight engines and are an integral part of the equipment, such as a chain saw. Four-cycle engines are larger and are usually mounted on the equipment utilizing a belt or chain drive system.

Both 4-cycle and 2-cycle gasoline engines have intake, compression, power, and exhaust strokes, in that order. In four cycle operation, as the piston moves down the intake valve opens and the air-fuel mixture is drawn into the cylinder. As the piston begins to move upward the intake valve closes and the air-fuel mixture is compressed. When the piston reaches the top of the cylinder the spark plug fires and ignites the air-fuel mixture, forcing the piston downward in the power stroke. In the next stroke, as the piston moves upward and the exhaust valve opens, the burned gases are exhausted. In two cycle engine operation intake, compression, power, and exhaust are accomplished in two strokes of the piston.

In gasoline engines the air-fuel mixture is ignited by a spark plug. High voltage electricity causes a spark or small arc to jump from one electrode on the spark plug to the other which causes the air-fuel mixture to burn rapidly. The high voltage is produced in a coil which has two windings. The primary winding has few turns and heavy wire, and current flows at low voltage. The current charge in the primary winding produces a high voltage and low amperage current in the secondary winding. The primary current is interrupted by breaker points which causes a rapid charge in the coil and provides high voltage current at the spark plug. In a battery ignition system the current for the primary winding comes from the battery. In a magneto system the current for the primary winding is generated by a rotating magnet that induces current in an iron core. The voltage in a battery or magneto ignition system may be as high as 20,000 volts. A minimum of 7,000 volts is required for initial starting.

Lubrication for four-cycle engines is provided by oil contained in the crank case. This oil is splashed onto the moving parts of the engine by the crankshaft as it rotates during operation. SAE 30 oil should always be used in small gasoline engines, and should be SC, SD, or SE grade.

Unlike four-cycle engines, two-cycle engines do not have oil in the crankcase, but require oil to be mixed with the gasoline to provide the lubrication. The following table shows different gasoline-oil mixture ratios.

Table 5-1
Gasoline/Oil Mixture Ratios

Gallons of Gas	Ratios	16:1	24:1	32:1	50:1
1 gal.	ounces of oil to be added	8 oz.	5 oz.	4 oz.	3 oz.
2 gal.		16 oz.	11 oz.	8 oz.	5 oz.
3 gal.		24 oz.	16 oz.	12 oz.	8 oz.
4 gal.		32 oz.	21 oz.	16 oz.	11 oz.
5 gal.		40 oz.	27 oz.	20 oz.	13 oz.

When operating a 2-cycle engine always consult the operator's manual for the oil-fuel mixture ratio, as this ratio varies for different engines and different brands of 2-cycle engine oil. Never use motor oil for oil-fuel mixtures. These oils have additives that will leave harmful deposits inside the engine. Be sure to mix the oil-fuel mixture thoroughly before pouring it into the engine fuel tank.

Most small gasoline engines are air cooled. They have fins on them to help cool the engine. It is important to keep the fins and the spaces between them clean or the engine will run too hot. Also, if fins are broken off that part of the engine will run hotter. The sheet metal covers and guards on small engines help direct air flow for cooling the engine. If these covers are removed of altered the engine could overheat.

Small Engine Operation

Prestart

1. On four-cycle engines check the oil and fuel. On two-cycle engines be sure to use the proper oil-fuel mixture.
2. Be sure the engine is clean and engine covers are in place.
3. Disengage the load if equipment permits.

Starting

1. Turn On-Off switch to on position.
2. If the engine has a choke, close the choke, if it has a primer, pump the primer two or three times.
3. Set the throttle approximately one-half open.
4. Pull the starter rope or use electrical starter.
5. When the engine starts, open the choke and allow engine to idle and warm up for two to four minutes before opening the throttle fully.

If the Engine Won't Start (Troubleshooting)

1. Check ignition switch - be sure it is on.
2. Check the fuel - if the engine hasn't been run for several months old fuel may be the problem.
3. Does the engine have compression? Check by pulling the starter rope slowly to see if there is resistance on the compression stroke.
4. Check the spark plug - if it is wet the engine may be flooded or there may not be any spark. If the spark plug is dry, no gas may be getting into the cylinder.
5. Check for spark by resting the spark plug against the engine and pulling the starter rope. Look for an arc between the electrodes.
6. If the engine has no spark or no compression it should be sent to the shop for repairs as this will require special tools.
7. If the spark plug is dry or wet and there is a spark, carburetor adjustments may be necessary. Check the engine operator's manual for correct settings.

Water Pumps

Construction projects where excavation is required can be hampered by rain water or ground water. These water problems are usually solved with small portable pumps which are set up and operated by laborers. There are two common types of portable pumps: centrifugal and diaphragm.

Centrifugal pumps can be electric, air, or gasoline powered. Electric centrifugal pumps are sometimes called submersible or sump pumps. These pumps have an impeller with fins that rotate at high speeds causing a suction in one direction which pulls water in and forces it out in the opposite direction. The electric motor and cord are sealed against water leakage and the pump is lowered directly into the water.

Air-operated centrifugal pumps are also called sump pumps, but are only partially submersible because the exhaust pipe must remain above the water. These pumps operate like electric centrifugal pumps except they are driven by an enclosed air motor powered by compressed air supplied by a flexible air hose from an air compressor.

Most commonly found on construction sites are gasoline powered centrifugal trash pumps. These pumps are not submerged. Unlike submersible pumps, a non-collapsible suction hose with a strainer and check valve is placed into the water. This type of pump must usually be primed by removing a plug on top of the pump and filling the housing with water before starting.

Diaphragm pumps work on the positive displacement principle. The flexible diaphragm (usually rubber or neoprene) covers a bowl-like chamber. A piston connected to a crankshaft raises and lowers the diaphragm changing the displacement in the airtight chamber. Two flap valves (work like check valves) regulate the suction and exhaust as the diaphragm raises and lowers. As with the trash pump a non-collapsible suction hose is placed in the water. Discharge hoses are used to transport the water to the desired location. Diaphragm pumps are usually gas-powered, but can also be electric-powered.

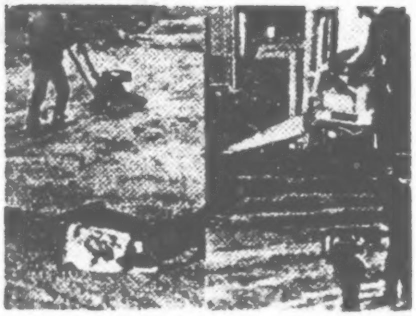
After pumping in below freezing weather, remove the drain plug and drain the pump to avoid damage from freezing. Run the pump about 15 seconds after removing the drain plug to assure that all water is removed. If pumping liquids with a high solid content, open the drain plug and flush the pump thoroughly with clean water. If solids plug the drain opening operate the pump while flushing with clean water or remove the end plate and flush out the remaining solids.

LABORERS-AGC TRAINING TIPS

No. 3

TRAINEE INFORMATION PROFILE SERIES

SMALL GAS ENGINES



Small gas engines power many machines laborers use. In order for you to work productively with these machines there are certain things you have to know about the operation, safety and maintenance of their engines.

This manual is designed as a supplement to the video "SMALL GAS ENGINES" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

TYPES OF ENGINES

There are four-cycle engines that run on regular gas, and two-cycle engines that run on regular gas, mixed with oil. Four-cycle engines have a crankcase and a separate oil system. Two-cycle engines do not have a separate oil system. The lubricating oil is mixed with the gas.

A standard two-cycle mixture is 16 parts regular gas to one part oil, or one pint of oil in two gallons of gas. But mixtures vary. Some are as high as 50 to one. Most four cycle engines run on regular gas, however, there are some four-cycle engines that run on diesel fuel.

PROPER FUELING

It is important to make sure you use the proper fuel and oil for each engine. You can burn up a diesel or two-cycle engine by running it on straight gas. Planning ahead means each can should be labeled to avoid mistakes.

Always check the instruction plate or ask your labor foreman for the fuel or mixture to use. **Never smoke when mixing or pouring fuel.**

Safety cans have a spring cap that helps keep moisture and dirt out of the fuel. These safety-can spring caps and spouts help prevent accidental spillage. Always wipe the spout and the outside of the can clean. Then check and clean the inside of the spout and strainer.

If you are using a gas-oil mixture, mix enough fuel to last the whole day. Outboard motor oil is widely used for two-cycle engines. If you do not have outboard oil, use a 30-weight, non-detergent oil in your mix. Make sure you add the right amount of oil. You can damage or gum-up a two-cycle engine with too little or too much oil.

Clean around the gas cap to keep dirt out of the tank. Shake the mix in the can before you use it. Fill the tank only three-quarters full. Be especially careful not to spill any fuel on a hot engine. Make sure the breather-pin hole in the cap is open. Always remember to tighten the fuel cap.

Clean up oil spills immediately to avoid dangerous slips and falls. Use sand, dirt or any absorbent to dry up spills. Be extremely careful when pouring gas and gas-oil mixtures. Gas spills can result in a fire.

If the machine uses other oil besides that in the crankcase, ask your labor foreman how to service it. Also, find out if it has any grease fittings, and how to service them.

CHECK LIST

With four-cycle engines check the crankcase oil before you start the engine in the morning. Check the oil every time you refuel, and at the lunch break. Use judgement to decide when the oil needs to be changed. Dirt and grime in the oil damages these engines.

Always drain the oil when the engine is hot; the dirty oil runs out easier. The oil used is 30-weight, non-detergent in summer and 20-weight in winter. Newer engines may require high detergent oil, so always check engine specifications.

Check and tighten all nuts, bolts and screws. Certain nuts and screws have to be checked and tightened several times a day. Ask your labor foreman to point these out.

Check the spark plug wire. Frayed, kinked or cracked wire should be reported. The spark plug connection should be tight.

Air cleaners should be serviced regularly; for the oil-bath type once each week, or even daily under very dusty conditions. Remove the cap, and clean out the old oil. Then refill to the indicated level.

To clean the dry-element type, tap the element firmly to break loose dirt particles and blow out with air, when available.

The oil-foam type should be cleaned every 25 hours of operation, more often under dirty conditions. Wash the foam element in kerosene or liquid detergent and water. Then squeeze dry. Saturate foam in engine oil, squeeze to remove excess oil, and then reassemble the parts.

START YOUR ENGINES

Starting small gas engines can be a problem, but there are some standard starting procedures.

Open the fuel valve, so fuel can flow to the carburetor. Set the choke to the starting position. Make sure the choke closes completely.

Set the throttle about one-third open. Take about three short, easy pulls on the starter rope to get the engine on a compression stroke. When you pull to start, use a short, sharp pull to avoid damaging the spring-loaded re-wind. Pull straight out and level the re-wind housing. Find the compression stroke each time before starting a pull, and never let the starting rope snap back by itself.

The engine should start within several pulls. When it does, open the choke. Let the engine warm up for two or three minutes before you set the throttle back to idle.

STOPPING PROCEDURES

There are also standard stopping procedures. First, run the engine at idle for two or three minutes to cool it off. Some small engines have a shorting bar. Bring it into contact with the spark plug and the engine stops.

On other engines there is a "stop" button that shorts out the ignition. Some small engines have an ignition switch. In one direction it is in the "off" position, and in the other it is "on". Never use the choke to stop engine.

After stopping the engine, be sure to close the valve on the fuel tank. Always check the instruction plate or ask your labor foreman about starting and stopping procedures.

STARTING PROBLEMS

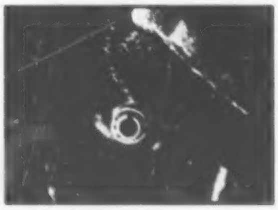
All two - and four-cycle engines will start and run well if they have compression, get the right amount of the proper fuel, and the right spark from the ignition.

If the engine doesn't start after several starting pulls, it may be flooded. Gas on the carburetor, or a strong smell of gas usually means flooding. If this is the problem, open the choke and let the engine set a few minutes before trying to start it again. If the engine isn't flooding, and it still won't start, remove the spark plug to see if fuel is getting to the cylinder. The spark plug should be wet with fuel. If it is dry, and the fuel line is open, then there is probably a carburetor problem. Report this your labor foreman.

If it is wet, check the ignition system for proper spark. A quick and practical way is to first replace the spark plug with a new plug and gasket. The plug should be properly gapped to specs.

Make it a habit to only hand-tighten, or hand-tighten with a socket-only, when you put a spark plug in. This will prevent stripping the head. When hand tight, then take up one-quarter turn with a wrench.

If the engine still fails to start, check further for ignition failure by shorting the plug to a bolt, but use caution to avoid a shock. You should get a blue spark. A weak orange spark, or no spark at all, means there is an ignition failure. Report this to your labor foreman.



If a new plug is not available, clean the old plug with a wire brush, or with a knife. Check the gap with a feeler gauge, set it to specs, and then re-check before replacing.

Carburetor adjustments vary from machine to machine and should be performed by a qualified person.

If the machine you're using lacks compression, or uses oil excessively, be sure to report this to your labor foreman. If your machine is damaged while in use, be sure to red-tag it. A red tag means "broken equipment in need of repair."

STORAGE

When an engine is not going to be used for two or three weeks, prepare it for storage. Start and run the engine to warm it up. Close the fuel line and let the engine run to clear the carburetor of fuel. Then, drain the fuel tank.

Drain and refill the crankcase on four-cycle engines. Clean and service the air filter. Remove the spark plug and put a capful of light oil in the cylinder. Outboard motor oil is okay. Pull the starting cord several times to distribute the oil. Then replace the spark plug. Finally, clean off the engine and wipe it with a soft, oily rag.

Practice with these small engines and machines, and asking questions are the "keys" to gaining confidence. You can make your work easier for yourself, and make the engines more effective by learning how to operate and maintain these small engines correctly.

KEY POINTS TO REMEMBER

- USE THE PROPER FUEL AND OIL FOR EACH ENGINE.
- LABEL EACH CAN TO AVOID COSTLY MISTAKES.
- CLEAN OIL SPILLS IMMEDIATELY.
- CHECK OIL SEVERAL TIMES A DAY.
- CHECK SPARK PLUG WIRE FOR DAMAGE.
- FIND THE COMPRESSION STROKE EACH TIME BEFORE STARTING A PULL.
- NEVER LET THE ROPE SNAP BACK BY ITSELF.
- NEVER USE THE CHOKE TO STOP THE ENGINE.
- RED TAG DAMAGED EQUIPMENT.

General Occupational Safety and Health Regulations
Small Gas Engines

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Flammable and Combustible Liquids	29CFR 1926.152
Fire Protection	29CFR 1926.150
Fire Prevention	29CFR 1926.151

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts.

Laborers-AGC Education and Training Fund wishes to thank the following for their help in revising this manual:

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ALL PURPOSE SAWS

Operating The Portable All-Purpose Saw

Refer to OSHA 1926.302(c) Fuel Powered Tools

All fuel powered tools shall be stopped while being refueled, serviced or maintained, and fuel shall be transported, handled, and stored in appropriate containers. When fuel powered tools are used in enclosed spaces the applicable requirements for concentrations of toxic gases and use of personal protective equipment shall apply.

In sewer and water construction the portable all-purpose saw is used to cut a variety of different materials, including concrete, ductile iron, steel and plastic pipes, or wood and steel members used for shoring operations.

Personal protective equipment needed for the safe operation of a portable all-purpose saw should include: safety goggles or face shield, ear protection, work gloves, and hard hat. When sawing concrete pipe or other materials that give off dust, a respirator fitted with proper filter cartridges should be used.

All-purpose saws are powered by a two-stroke engine and the fuel used must be mixed with two-cycle engine oil. Be sure the proper mixture, according to the manufacturer's recommendations, is used.

If the gas mixture for the all-purpose saw has been stored for an extended period, be sure to shake them thoroughly before using, as the gasoline and oil mixture will begin to separate.

The all-purpose saw uses a variety of different blades. Abrasive blades can be used for cutting concrete, ductile iron, and steel. Diamond blades are used for cutting concrete, but the saw must be fitted with a water attachment. Wood cutting blades are similar to those used on table saws or portable skill saws.

Cutting blades for free-hand cutting operations are subjected to particularly high bending and compressive stresses. Top quality blades which match the engine characteristics must be used. Out-of-round or poorly balanced blades increase vibration and reduce the service life of the all-purpose saw. Abrasive blades are heat sensitive and should be stored in a dry place at a constant temperature.

When starting an all-purpose saw, place the saw on the ground, be sure nobody is in the working range of the saw, and the blade is free of all obstructions. A cold engine is started with the choke in the closed position, regardless of the time of year, and a warm engine is started with the choke in the open position.

Move the ignition switch to the "on" position and set the throttle trigger to the half throttle position. Hold the handle bar with one hand and pull the starter grip with the other hand until a definite resistance is felt, then give a strong, brisk pull. Do not allow starter rope to fly back. Keep the choke closed only until the engine fires, then move it to the open position. If the engine stops, repeat the procedure. If the choke is left closed after the engine fires the engine will flood. When the engine is started, "warm" it up by revving briefly to full throttle several times. The engine is stopped by moving the ignition switch to the stop position.

Before making a cut, always adjust the bladeguard so the user is not endangered by particles of the material being cut and be sure your safety goggles are on.

When cutting, the saw should be operated at full throttle. Let the blade cut freely and do not use force to push the cutting blade into the work. To achieve a clean and efficient cut, pull the cutting blade across the work or move it forward and backward in the cutting direction. After the cut is complete the engine should be turned off. Never move from one cutting job to another with the engine running.

When carrying an all-purpose saw, be sure the blade is facing the rear. Always remove the blade when transporting the saw to avoid damage.

When sawing concrete with abrasive blades, a large amount of dust is given off. The air filter's function is to intercept dust and dirt in the combustion air, and thus reduce wear on engine components. Clogged air filters reduce engine power, increase fuel consumption, and make starting more difficult. Portable all-purpose cut-off saws are equipped with a main filter element and an auxiliary filter. The main filter element should be changed as soon as engine power begins to drop off. The auxiliary filter protects the engine if the main filter element becomes damaged. In high dust conditions the air filter should be checked every half hour to prevent poor engine performance.

LABORERS-AGC TRAINING TIPS

No. 5

TRAINEE INFORMATION PROFILE SERIES

PORTABLE ALL-PURPOSE SAWS

This manual is designed as a supplement to the video "PORTABLE ALL-PURPOSE SAWS" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

The portable all-purpose saw is a handy tool used by laborers to cut many different materials quickly and evenly. You can use the portable saw to cut pipes of all sizes, made of aluminum, iron, and steel, concrete, masonry, and terra-cotta.

The saw will cut-out or "score" squares and rectangles in walls, pavements, and floors. You can cut out for trenches so that utility lines can be laid in floors and pavements. You can cut wood, you can cut angle irons, and you can cut re-bars.

As a matter of interest, it is also used by rescue squads to free people trapped in automobile wreckage. Because of its many uses, it is used often by laborers. So it's important that you learn how to care for and operate it safely.

DIFFERENT BUT SIMILAR

There are several different makes and models of portable all-purpose saws, but they have basic features which are similar:

- a heavy-duty two-cycle engine
- a dual air-filter system
- an engine starter cord
- an "on/off" switch
- a throttle trigger
- a moveable blade guard
- a drive belt or V-belt
- circular blades.

TYPES OF BLADES

- abrasive blades for cutting concrete.
- abrasive blades for ductile
- abrasive blades for cutting steel.
- diamond blades for cutting concrete
- blades for cutting wood.

If you're assigned to use one of these saws, check it out thoroughly before you take it on the job. First, make sure you have a complete unit - saw, blades, tools, spare plugs and filters, fuel, safety goggles, respirator, and a carrying case. In addition to your hard hat and safety shoes, you should have work gloves and ear protection.

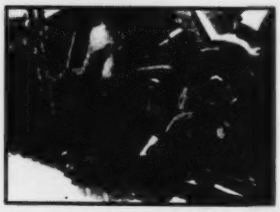
Your labor foreman will tell you the type of material you will be cutting, so that you'll know what type blades, and how many you'll need.

Always check the maximum operating speed, printed on the blade. It should match or exceed the RPM rating of the saw. Using a low-rated blade on a high-speed saw could result in the blade coming apart.

PREPARATION

Always fuel in a safe area away from the work site. You should mix enough fuel to complete the job or to last for the entire day. Fill the tank about three-quarters full. Wipe off any fuel that may have spilled onto the saw.

Remove the circular air filter and clean it by gently tapping it to remove any dirt and dust. If it is too clogged with dirt, replace it with the spare. Check the fl filter also. If it is dirty, replace it.

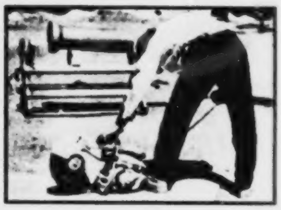


Check to see if the drive belt is loose. If it is loose, adjust and tighten to specifications, then return the belt guard. After you replace the guard, tighten all loose nuts, bolts and screws. Then clean the arbor shaft and flanges, and install the blade.

Proper alignment of the blade is important. A blade out of line could crack and shatter. Tighten securely, using the proper tool. Then, adjust the blade guard and tighten in place.

When you have finished fueling and routi maintenance, move away from the fueling area and check to make sure the engine starts and is in good working order before you move to the work area.

STARTING THE SAW



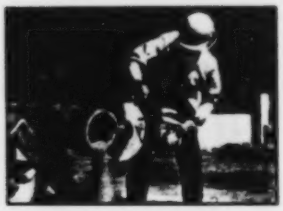
Press the ignition switch to "on," and prime or choke the engine. The choke should be closed completely. Place one foot through the handle-opening to hold down the saw. One hand should grasp the handle brace. Take two or three short, easy pulls on the starter rope to get the engine on a compression stroke. The engine should start within several pulls. Return the starter cord to its normal position without letting it snap back.

When the engine starts, "rev" it up at le than full throttle. Let the engine warm up before returning it to idle. If the engine does not start, it could be the spark plug. Follow the standard ignition checks that you would apply to any small gas engine. The engine may be flooded. A strong smell of fuel is a good indication. If so, make sure the choke is opened. Let the engine set for a few minutes and then try to start again.

MAKING THE CUT

Before cutting, put on your safety goggles. If you're cutting concrete, tile or any material that gives-off dust, a respirator should be used.

Begin cutting at full throttle and always cut at that speed in any material. Never force the blade and do not jam it into the cut. This can cause it to break in the cut. Let the blade cut freely. For most cuts a gentle, back and forth rocking motion should be used. If your cut starts to go out of line, don't try to force it back, start a new cut.



Cutting tile and concrete produces a lot of dust. The air filters should be checked frequently, and under severe conditions, as often as once every half hour.

Cutting metal does not produce much dust, and filters need not be checked or replaced as often. But sparks can be a problem, especially around your feet. Wear pants without cuffs and hi-top safety boots.

The water attachment on the top of this saw is always used when cutting concrete with a diamond blade. It is also used to reduce sparks in highly-combustible areas. When using water always hold the saw firmly with both hands, and follow the cutting line.

When you are moving from one cutting job to another, even if it's in the same work area, the engine should be "off." And always be sure to carry any portable saw with the blade facing to the rear.

If there is any possibility of the blade being damaged in transit, remove the blade and never carry the saw, or any gas-powered equipment, in the cab of a truck. An accident can cause gas spillage, resulting in fire or explosion.

WHEN THE JOB IS DONE

When you are finished, remove the blade before storing. Clean the entire saw assembly with a rag to get rid of dust, debris and oil. Tighten loose screws, nuts or bolts, and report anything that needs repair or replacement to your labor foreman.

Return the saw, blades, tools, and spare parts to the protective carrying case. The saw should never be stored with the blade attached.

The portable all-purpose saw can do a variety of cutting jobs, on many different materials. It can be a valuable and safe tool if you follow all of the manufacturer's operating, maintenance instructions and safety procedures when you use it. With practice and training you can become effective in operating the portable all-purpose saw.

KEY POINTS TO REMEMBER

- ALWAYS WEAR THE PROPER SAFETY EQUIPMENT.
- KEEP YOUR SAW IN GOOD WORKING ORDER.
- ALWAYS USE THE RIGHT TOOLS AND PARTS.
- KEEP THE BLADE IN PROPER ALIGNMENT.
- KEEP FELLOW WORKERS AWAY FROM THE FRONT OF THE SAW.
- ALWAYS CUT AT FULL THROTTLE.
- NEVER FORCE THE BLADE IN THE CUT.
- KEEP ENGINE OFF WHEN MOVING FROM JOB TO JOB.
- THE MAXIMUM OPERATING SPEED ON BLADE SHOULD MATCH OR EXCEED RPM RATING OF SAW.
- CARRY SAW WITH BLADE FACING TO THE REAR.

General Occupational Safety and Health Regulations
Portable All-Purpose Saws

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Power Operated Hand Tools	29CFR 1926.302
Occupational Noise Exposure	29CFR 1926.52
Flammable and Combustible Liquids	29CFR 1926.152
Fire Protection	29CFR 1926.150
Fire Prevention	29CFR 1926.151
Abrasive Wheel and Tools	29CFR 1926.303
Gases, Vapors, Fumes, Dust and Mists	29CFR 1926.55
Tools - Hand and Power, General Requirements	29CFR 1926.300

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CHAIN SAW SAFETY

Personal Protective Equipment

You must protect yourself from the hazards of every job, especially when operating a chain saw. Injuries suffered while using the chain saw are much more serious and last longer than most other job related injuries. Studies have shown that you are less likely to suffer injury if you take the time and care to protect yourself properly.

Hard Hats

The hard hat that you wear on any job should be approved by the Underwriters Laboratory or some other approval agency. Experts recommend that the harness is changed every year and that the plastic cap is replaced every two or three years. The plastic will eventually break down. If the hard hat is too old it may not provide proper protection when you need it.

It is also very wise for you to wear a chin strap so that the hard hat stays on your head.

Hearing Protection

It is a smart move for you to wear ear muffs rather than ear plugs to protect your hearing. Your skull bones pick up the vibrations of the chain saw and the plugs do not protect you from these vibrations.

Eye Protection

It is highly recommended that you wear a visor that has a mesh so that your eyes and face are protected from flying chips and dust. You must wear adequate eye protection to shield your eyes from serious injury.

Leg Protection

When a chain saw accident occurs, statistics show that in 90 percent of the cases a laceration, cut or puncture is likely to occur. One out of three of these injuries would be a cut to the legs. That is why it is so important for you to wear some form of leg protection. Full length safety pants with the long ballistic nylon pads are most recommended.

Gloves and Mitts

Twenty per cent of the cuts could be found on the hands and fingers. If you wore gloves lined with ballistic nylon your hands and fingers would be protected.

Safety Footwear

Your footwear has to be approved. The best boot for you to have is high topped, steel toed, non-slip, with a ballistic pad in the front. Some boots have studs in the soles to prevent you from slipping and falling. Boots with studs are called corked boots.

Tools and Equipment

Wedges

Wedges will make your job easier and safer. They are usually made of alloys or plastic. This allows them to take the pounding and banging when they are wedged into the tree. They will not damage the chain saw if they are accidentally cut. Once the cut has been started, the wedge is put in place to open up the cut. This prevents the saw from binding. The wedge also helps the chain saw operator to control the direction the tree will fall. When the tree is on the ground the wedge can be used to prevent the saw from binding while "bucking up" the log.

An axe, hammer or driving club can be used to pound the wedge into place. Sometimes smooth-faced wedges will pop out of the cut, especially on a wet day. Roughing up the smooth surfaces with an axe will help the wedges stay in place. Some manufacturers put a rough finish on the wedges right at the factory, making it a lot easier for you to get the job done.

Files

A properly sized round file is used to sharpen the cutters on the chain. The combination flat file is used along with the depth gauge to file the depth gauges on the saw chain to the proper height. The pointed end or "tang" on the file should have a wooden handle placed over top of it or it should be bent over at the very least.

Depth Gauge

The proper sized gauges will help you to set the depth gauges on the chain saw.

T-Wrench

This "t" shaped wrench is a combination screw driver and spark plug wrench.

Fueling the chain saw

When you fuel the chain saw you should use clean, regular gasoline in most instances. Some newer models may use unleaded gasoline, so check the manufacturers specifications before attempting to fuel the saw. Use the proper gasoline mixture depending on the season. The gas-oil mixture should be heavier in colder weather and lighter in warm temperatures. Anytime the chain saw is stored for a long period of time, the gas and oil should be drained and a few drops of oil should be placed down the spark plug hole. This technique should be followed when storing small engines for any period of time. If you find gasoline that has been in a chain saw that has been sitting unused for two or more months, you should drain the gasoline.

Check the manufacturers specifications so that you can add the proper type of oil to the chain saw. Two cycle engine oil is mixed with the gasoline and put into the fuel tank. Chain saw oil is put into the chain oil reservoir so that the chain is kept lubricated at all times while the chain saw is running. The chain saw operators manual will tell you the proper engine oil/gasoline mixture. The engine oil container will tell you how to mix the proper ratio given in the operators manual. The most common mixture is 16 parts of gasoline to 1 part of oil. The 16:1 ratio should be used unless the operators manual tells you that a different mixture should be used.

Fire Extinguisher

In hot, dry climates a high fire hazard can exist so a fire extinguisher is kept nearby at all times. A damaged chain saw muffler will create a fire hazard in no time so you should inspect it for flying sparks, on a regular basis.

Spare Parts and Equipment

There are times when the chain saw will break down. That is why you should have the following spare parts on hand:

- anti-kickback saw chain
- air filter
- spark plug
- starter spring
- starter rope
- guide bar nuts
- casing and cover screws
- operators manual

Fluorescent Flagging

A good faller will always have fluorescent ribbon so that if there are any hazards, like a hung up tree, for instance, it can be marked so that other fallers are aware of the danger.

Chain, Bar Cover, or Carrying Case

These coverings protect the saw and they also protect the operator from any cuts that might occur if they were not in place.

Dangers of the Chain Saw

The chain saw holds many hidden dangers. If you know about them you can protect yourself. These dangers include:

- kickback
- cuts
- noise
- broken chain
- back injury
- vibration
- burns

Kickback

The tip of the guide bar can jam and "kick back" into your face or body. Since kickback can occur faster than you can react you must take preventative measures:

- Never touch anything with the wrong part of the bar nose.
- Never let the saw bind on a log that is under tension.
- Take extra care when limbing bushy trees.
- Take extra care when brushing out an escape route.
- Know the proper way to make a "boring" cut.

There are ways to either totally prevent or reduce the risk of kickback:

- Wear personal protective equipment.
- Do not touch anything with the bar nose.
- Do not cut with the wrong part of the nose.
- Always cut at full throttle.
- Do not stand directly behind the chain when cutting.
- Know where the bar tip is at all times.
- Make sure your thumb is gripped around the front handle.
- Hold the saw securely.
- Do not operate the saw when you are tired.
- A short guide bar reduces kickback force.
- Use a sharp safety chain.
- Do not go any lower than the proper depth gauge limits.
- Use a filing guide.
- Keep the chain at the proper tension.
- Make sure the chain brake works.

Cuts

To avoid cuts:

- Wear personal protective equipment.
- Do not push on the tree and cut it at the same time.
- Many injuries happen because the operator did not know where the bar was at the time.
- Stand to the side of the chain.
- There is very little risk of cutting yourself if you point the chain saw, opposite to the direction that you are walking in.
- Keep in mind that kickback occurs most often while you are limbing.
- Never drop start your saw (this can be very unsafe).
- Never cut above the shoulder.
- Wear gloves when you are working with the chain.
- Remember to let off on the throttle

when you make a cut with a pushing chain.

Noise

The chain saw is a very loud machine that will create readings over and above 115 decibels. The unwanted sound will cause fatigue and hearing damage.

Hearing Loss

The chain saw can cause temporary hearing loss during the first 2 hours of exposure. It can take as long as 16 hours for your hearing to return. This temporary hearing loss can become permanent. You may experience ringing in the ears and your hearing may not bounce back as quickly as it should.

Hearing Protection

Ear muffs will protect your hearing while you are working around the chain saw. Ear muffs can be washed with soap and water. They should be replaced if they are not creating a good seal. You can prevent your hearing loss from getting any worse if you start protecting your hearing right away. Ear muffs cut down a lot of distracting noise, making it easier to concentrate on your work. It is actually easier to understand someone who is talking to you over the sound of the loud chain saw.

Broken Chain

To avoid serious injury from the high speed chain on your saw:

- Make sure that your saw has a chain catcher and a rear hand guard.
- Wear gloves with ballistic nylon inserts.
- Always keep your chain sharp, well lubricated with the correct tension.
- Make sure that the rivets and links are free from cracks and defects.
- Maintain your chain more often in cold weather.
- Set the chain gauge depths properly.
- Never abuse the saw.

Back Injury

Prevent your back from injury:

- Put your elbows on your knees to prevent fatigue, when possible.
- Use the trunk of the tree as extra support whenever you can.
- Keep your back straight when making a lift.
- Keep your knees bent.
- Use both hands when making a lift.
- Do not over-reach.
- Do not saw the tree and push on it at the same time.

Vibration

The vibrating chain saw can cause a circulatory disease called "Raynaud's Phenomenon." You may have heard it being called "white finger" or "dead hand." If you do not protect yourself from the cold, wet weather, and chain saw vibrations, you could become another victim of white finger. You can protect yourself from this disease by using anti-vibration devices, wearing warm gloves, holding the saw properly and keeping the chain sharpened.

Burns

Burns are caused by coming into contact with hot mufflers, chains, cylinders and spark plugs. You can prevent burns by waiting for the saw to cool before working on it. Another way to prevent burns is to carry the saw correctly.

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CHAIN SAW ORIENTATION

In order to run a saw safely an operator must know all that there is to know about the parts of the saw and its safety features.

Operator's Manual

Always read the safety manual and the operator's manual for your chain saw.

Parts of the Saw

Can you locate all the parts of your chain saw?

- The **starter handle** is a "t" shaped handle that you pull on to start the saw.
- The **starter pulley** is connected to the flywheel. Once the engine starts up the pulley automatically pulls away from the flywheel.
- The **flywheel** keeps the engine R.P.M. constant and the **fan** cools the engine.
- The **ignition switch** is used to turn the chain saw on and off.
- The **choke** controls the amount of air that gets into the carburetor.
- The **throttle latch** locks the throttle at half speed so that the chain turns as soon as the saw starts.
- As you squeeze the **throttle trigger** the engine revs faster and faster.
- The **carburetor** combines the fuel and the air and also pumps the fuel from the tank.
- Your chain saw will have a **Tillotsan carburetor**. This type of carburetor has two diaphragms so that the saw can be tipped or held in any way without the fuel supply being affected.
- There are three types of **carburetor adjusting screws**. The **low speed jets** control the engine speed during low R.P.M. and the **high speed jets** control the operation of the chain saw at full speed. The **idle speed screw** naturally controls the engine speed while it is idling.
- The **fuel filler cap** covers the fuel tank.
- The **oil filler cap** covers the chain oil tank.
- The **air filter** protects the carburetor from dust and dirt. A dirty air filter will cause your saw to lose power and run too rich. This means that deposits will ruin the engine.
- The **cylinder cover** protects the carburetor from damage and provides some protection for the operator.
- The **starter cover** protects the starter.
- The **clutch cover** houses the clutch and the chain brake.
- The **saw bar** has grooves that the chain follows. If the bar and chain are lubricated on a regular basis they will last much longer.
- There are two types of **sprockets** that drive the chain. The **spur type** looks like a gear that is attached to the clutch drum. The **rim type** has a small ring with holes in it that guide the chain drive links.

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- The **clutch** will let the saw run while the chain is stopped.
- The **spark plug wire** feeds electricity to the **spark plug**, which in turn creates a spark to ignite the air/fuel mixture in the cylinder.

Safety Features

The safety devices on a chain saw should always work properly. A chain saw is equipped with many safety devices. A **front handle** that is covered in rubber to reduce vibrations and to give you a better grip on things. The front handle is normally held in the left hand if you are right handed or left handed. If you hit the **front hand guard** and knock it forward the **chain brake** stops the chain in 1/8th of a second, protecting you from injury in case anything goes wrong. The **chain brake activator** kicks the brake into action. **Anti-vibration dampening** protects you from engine and chain chatter because these devices are usually made of rubber. The **rear hand guard** protects your right hand should the chain break. The **throttle trigger lock** prevents you from starting the saw accidentally. If the depth gauges are filed the proper amount the **safety chain** can help to reduce kickback, especially during limbing. The **anti-kickback chain** is well recommended since the cutter tooth design prevents the saw from digging into the wood. This type of chain can reduce the force of kickback up to 75 per cent. If the chain breaks it probably will not hit you if a **chain catcher** is installed on the saw. The **muffler** reduces the level of noise and decreases the amount of sparks that could fly out of the saw. **Dogs or bucking spikes** help to control the saw while you are cutting. The **guide bar cover** protects the bar and chain and it protects you as well. The **carrying case** holds the saw during transportation.

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Preparing the Chain Saw

When preparing a chain saw you must put the bar and saw chain on the saw and set the chain tension. In this module there are three topics that will be discussed:

- setting up the chain saw
- fueling the saw safely
- chain oil

Installing the Guide Bar and Chain

Follow these steps when installing the bar and chain:

- Read the operator's manual.
- Turn the ignition switch off.
- Disengage the chain brake.
- Take the guide bar nuts and the clutch cover off.
- Place the bar onto the chain tension screw and the bar nuts.
- Place the chain in the groove on top of the bar, starting at the sprocket.
- The chain runs in a clockwise direction so the front edge of the cutters must face the tip of the bar.
- Make sure that the chain brake is off when the chain is replaced or removed.
- Finger tighten the guide bar nuts.

Set the Chain Tension

Whenever you have saw chain problems a loose chain most likely caused the problem. Make sure that the chain fits around the bar and sprocket by pulling the chain around the bar. Turn the chain tightener screw in a clockwise direction until the proper tension is reached. Hold the tip of the guide bar up while you tighten the guide bar nuts. Move the chain back and forth to see if it moves freely on the bar. Check to see if the chain break works. If the brake does not work then refer to the operators manual.

Starting the Saw

Follow these safety precautions, before you start the saw.

Pre-Start Checks

- Check the saw parts and the safety devices.
- Check the air filter.
- Check the chain tension.
- Check the chain.
- Check the fuel and chain oil levels.

Starting the Saw

The chain saw should never be started unless the chain and the guide bar are attached because the clutch can fly off if they are not attached. Check the owners manual to see how to set the choke and throttle.

The chain saw may be started when the engine is cold or hot. The steps that you take to start the saw when it is warm are the same as when the saw is cold except that you do not need to use the choke when the saw is already warm.

To start the chain saw when it is cold:

- Turn the ignition switch on.
- Pull out the choke control.
- Press on the throttle trigger and the throttle lock latch at the same time to lock in the throttle control.
- Put the saw on the ground and make sure that the chain is not touching anything.
- Put your right foot on the rear handle and your left hand on the front handle.
- Pull on the starter handle slowly until you can feel the starter engage, then give the rope a short, fast pull.
- Do not let go of the rope suddenly because if it snaps back into the

saw the rope will damage the starter and it may break the rope. The best way to avoid this from happening is to let the rope back into the starter slowly.

- If and when the saw fires it is telling you that is ready to start on the next pull. This is your signal to push the choke in so that you can start the saw on the very next pull.
- If the choke is pulled out and you crank on the starter any more than 3 times you will probably flood the engine.
- Once the engine starts you must give it one quick rev to release the throttle latch.
- Do not be surprised to see the chain racing around the bar at this time. Keep in mind that this is a very dangerous time.
- Let the saw idle for a few minutes, until it has warmed up.
- When the engine is idling the chain should not be moving.

Shut Down

Turn the ignition switch to the off position. Make sure that when you set the saw down that the chain has stopped turning. Put the chain guard back on before you carry the saw away.

Oiler Check

The oiler can be checked really easily. All you have to do is run the saw at full speed while holding the bar about 6" away from a light colored surface. If a line of oil appears on the surface the oiler is working fine.

Running in a new chain

The chain is broken in by stretching it in a controlled manner. You can use the following steps to break in a chain properly.

- Soak the chain in lubricating oil for a little while.
- Put the chain on the bar.
- Start the saw and run it for 2 minutes.
- Do not cut anything during this period and make sure the saw chain is getting oil.
- Stop the engine and let the chain and the bar cool off before you work on the chain.
- Adjust the chain tension and then start up the saw so that you can make a few cuts in a log.
- Stop the engine and let it cool before re-adjusting the chain a second time (you cannot adjust the chain properly unless it has cooled off completely between each adjustment).
- Repeat these procedures until the chain stops stretching and it stays tight.

Basic Working Techniques

Carrying the Saw

The bar of the chain saw should point away from the body and the hot muffler should be pointed away from the body. If you have to carry the saw more than a short way then you should turn it off and engage the chain brake.

Proper Grip

Always wrap your left thumb around the front handle. If you are left handed you have to take extra care because the chain will be cutting directly in line with your body. When you grip the saw keep your wrists straight and let the rear handle pivot in your hand when you are working with it.

Working the Saw

Stand with your feet well planted and far enough apart so that you are positioned in a sturdy stance. The strain on your back can be decreased if you use your knees to support your elbows when you need to crouch or bend to make the cut. Use your leg muscles instead of your back muscles to do the work. There is a good chance that sawing and pushing on a tree at the same time will cause a back injury. The trunk of the tree is good support. Do not work on loose ground and never stand directly behind the saw blade if it can be helped at all.

The Three Basic Cuts

A Pulling Chain

A pulling chain does just that; it pulls you into whatever is being cut. This type of cut is easiest and the safest cut to make. The cut is made on the bottom of the bar. There is no need for you to force the saw because it practically feeds itself. Always use the dogs to hold the saw firmly into the wood.

A Pushing Chain

Cutting with a pushing chain is a dangerous but necessary cut to make. Since this cut is made with the top of the bar the rotation of the chain pushes the saw towards your body. To prevent being cut by the saw you have to push the saw into the wood. You have to remember to ease off on the force that you have on the saw just before the cut is complete because if you forget you could pull the saw into yourself.

The Boring Cut

Since the nose of the bar is used to make this cut it is the most dangerous cut because of the possibility of kickback.

In order to make this cut safely follow these procedures:

1. The tip of the bar should be at the 4 or 5 o'clock position to start the cut.
2. When you begin to cut into the log, cut as far as the depth of the bar.
3. Line up the saw in the direction that you would like to bore.
4. Support the saw against your leg if you can and rev the saw at full throttle as you push the bar into the wood.
5. Use the regular cutting techniques once you have bored through the log.

Stress Point Cutting

You have to take into consideration the forces like tension and compression on a tree each time you make a cut. When a tree is supported at both ends, the wood at the top of the log is pushed together, or compressed. The wooden fibers on the bottom are pulled apart in the opposite direction and they are said to be under tension.

If the tree is supported on one end, the wood on the bottom is compressed and the wood fibers on the top are pulled apart, or "placed under tension."

Tree Supported On Both Ends

The compression side of any log must receive a relief cut, to take away all the pressure, before the main cut is made. With this in mind you will understand why the following cuts are made on a tree trunk, laying on the ground, and caught up on both ends: Make a relief cut 1/4 of the way through on the top of the log and make your second cut on the underside of the log. If the saw becomes jammed, use your wedge to get it out. Always cut on the uphill side of the log.

Tree Supported On One End

To cut this tree you must make a relieving cut 1/4 of the way through the tree on it's underside. The relief cut is made on the compression in this situation, as well. The second cut will be made on the top side of the tree.

1. Stop sawing when you have a big enough space to fit the wedge into the cut.

2. As you are drive the wedge into place look up the tree every now and then to make sure that nothing will fall on you.

3. Continue the back cut and tap the wedge in as far as possible.

When To Discard a Saw Chain

You can throw a chain away when it has cracks in rivets or side links, too much wear at the bottom of the links, tight joints, damaged chromium plating, cutters worn beyond repair.

If a chain breaks once it will break again. When it comes time to throw a chain away, make sure that the bar and sprocket are not damaged as well. Even if the bar and sprocket are worn down, you should replace them before putting on a new chain.

Maintenance

You should maintain the bar by following these steps:

- Remove the bar and chain.
- Check the bar for wear and damage.
- Check the nose sprocket for wear and damage.
- Clean the bar groove.
- Remove any burrs from the bar groove.
- Check the bar groove depth.
- Check to see that the bar is getting lubricated.
- Lubricate the nose bar.
- Flip the bar over and re-install.

Let's talk about the maintenance steps in a little more detail:

When you take off the bar and chain you should remember to wear gloves so that your hands are protected.

The bar will wear faster on the side that you cut on the most. The side that you cut on the most is usually the underside of the bar so you should take some extra time to check this side of the bar. Check for cracks, worn rails or edges that have burrs on them.

You should check to see if the bar nose is turning blue or if the nose sprocket is spreading apart which will cause the bearing to fall out.

Make sure that the bar grooves are cleared of the sawdust and chain oil mixture that can gum up the groove. The oiler holes should also be cleaned out.

The burrs that you find on the edge of the guide bar can be taken off during the weekly maintenance checks. To do this you must remove the bar from the saw, holding the saw horizontally and filing the burrs with a flat file.

Look for any signs that may tell you that your chain is not getting enough oil. Look for any premature wear or any bluing of any of the chain parts.

The nose sprocket has to be greased every now and then, to prevent any moisture from building up in the sprocket and cleaned to remove any foreign matter. The lubrication will extend the life of the saw.

To grease the bar you should clean the grease holes in the sprocket with a nail or wire. Lay the bar flat and insert the gun into the hole. Pump until you see that grease is coming out around the sprocket. You should use a good quality lithium based lubricant.

Once you have serviced the bar it should be flipped over to increase its' life span.

You can check to see if the guide bar has worn down to a point that it needs to be thrown away. What you do is place a straight edge against one cutter and the side of the bar. It you find that there is no clearance then it is time to replace the bar.

Sprocket Damage

A worn sprocket will damage a new chain really quickly so you should never install a new chain onto an old worn out sprocket.

You can decrease the amount of problems that you will have if you do the following:

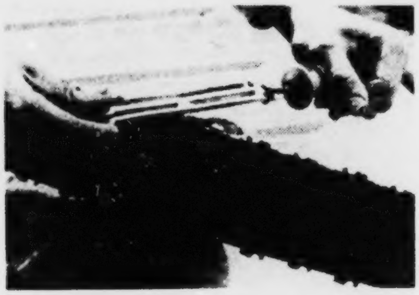
- Keep the chain sharp.
- Keep the guide bar rails in good condition.
- Lubricate the guide bar nose if it is a sprocket type.
- Lubricate the sprocket bearing.
- Inspect the sprocket now and then, especially when you install a new chain.
- Make sure that the sprocket is lined up properly.

LABORERS-AGC TRAINING TIPS

No. 13

TRAINEE INFORMATION PROFILE SERIES

CHAIN SAW SHARPENING

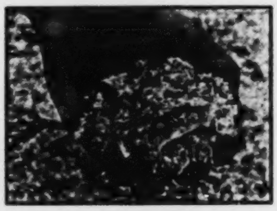


This manual is designed as a supplement to the video "CHAIN SAW SHARPENING" and to the hands-on training you will receive at your local training site.

We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

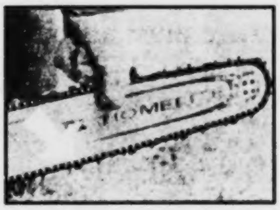
Because of its many uses, the chain saw is important to the laborer. But to be useful, it must be cared for. This means it must be sharpened and lubricated frequently and correctly. You can tell when your saw needs sharpening, by how it cuts.



A saw, that's sharp will feed itself into the wood. A sharp saw will make wood chips like those shown in the picture.

When you have to push your saw through a cut, or when you start to get sawdust instead of wood chips, stop cutting and sharpen the saw.

CHECK THE TENSION



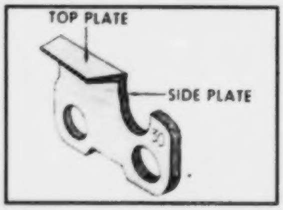
Before sharpening the saw, check the chain tension. The bottoms of the side links and cutters should just barely touch the bottom of the bar in the center. Pull the chain around the bar by hand, to make sure the chain is properly mounted on the sprocket. Use caution and wear gloves whenever handling the chain; the cutting edges are very sharp.

USE THE RIGHT TOOLS

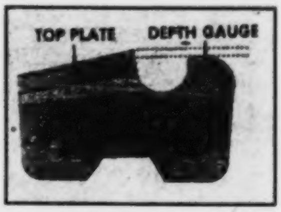
Whenever you sharpen a chain saw, you must use the right size sharpening tools. These tools differ, not just among the many chain saw manufacturers, but even by the same manufacturer. The ones you use, will depend on the type of chain you have on your saw. If there is any doubt, check with your foreman and in the chain saw manual, for this information. In most cases, you'll need:

- a round file
- a file holder
- a flat file
- filing gauge

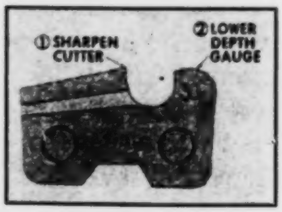
A standard saw chain has alternating cutter and drive links held together by side links and rivets. There are left-hand cutters, and right-hand cutters shaped so that the top, inner edges of each alternating cutter overlap, and cut the wood in small chips or bites. Each cutter has a top plate and a side plate, which must be sharpened and re-sharpened, to keep the chain at top performance.



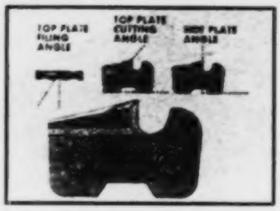
To control the amount of wood the top plate can cut in one bite, each cutter has a leading edge, called a depth gauge. The proper depth gauge setting, is stamped on the side of the depth gauge. The cutter pictured here cuts at approximately 1/30th of an inch. As the top-plate becomes worn and is re-sharpened, the depth gauge must be lowered, to keep the correct cutting bite.



Sharpening is done in two steps: first, all the cutting edges are filed, and then, all the depth gauges are lowered.

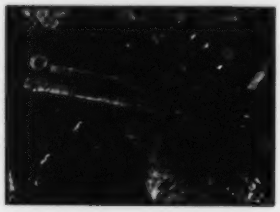


The cutter has 3 angles; the top plate filing angle, the top-plate cutting angle, and the side-plate angle, that are sharpened with the same stroke. The cutter angles may vary depending on the manufacturer so always be sure to use the correct file holder.



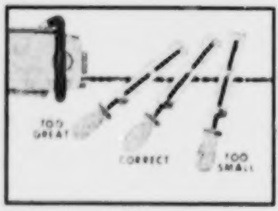
SHARPENING

First, place the round file in the holder. Line up the mark on the file holder, parallel to the chain. This will give you the exact filing angles. Press the holder firmly against the top of the cutter. Keeping the holder level, take three even strokes on the first cutter. Then check to see if it's sharp. If it is, take three strokes on all cutters, using the same pressure. Remember to push the file through the cutter from the "inside" to "outside." Apply pressure only on the forward stroke.



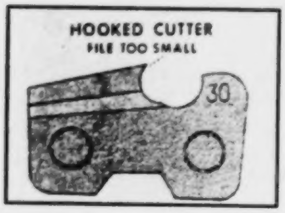
To help keep a level position when sharpening, most manufacturers recommend that all cutters be filed at, or near, the same place on the top of the bar. So, after finishing three or four cutters move the chain along the bar, until the next series of cutters to be sharpened are in position. Sharpen all the cutters on one side of the chain first, say all the right-hand cutters. Then, switch the holder (or move to the other side of the bar) and file all the left-hand cutters. Remember, always file from the inside to the outside of the cutters. Try to use the same number of strokes and the same pressure on each cutter. Don't forget to rotate the file from time-to-time when sharpening.

Holding the file at the wrong angle when sharpening will make the top-plate filing angle too-great or too-small. It's most important that you line up the marks on the holder with the bar. Too great of an angle on the top-plate makes a thin,

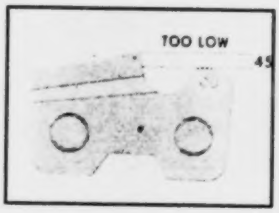


sharp, side-plate. This pulls the chain out-of-line on the bar, and causes excessive wear. Too small an angle makes a blunt side-plate, and the chain won't feed into the wood. A chain sharpened at the correct angle will feed itself evenly into the wood. Always use the correct file.

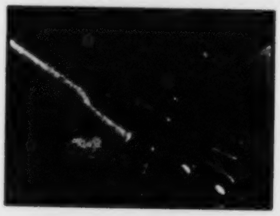
A hooked cutter, pictured, will feed well and cut fast for a short time, but it dulls quickly . It's caused by using a file that's too small. If you use too large a file, you cause a back-sloped cutter, which will not feed itself into the wood. Constant sharpening causes a gullet, that has to be filed down with a round file.



When you finish sharpening, check the depth gauges, the part that controls the amount of wood the cutter removes. A gauge that's too high, will prevent the top-plate from cutting into the wood and the saw will not feed itself into the cut. One that's too low, will allow the top-plate to grab too much wood. The cutters will chatter and bounce, causing loose rivets and, eventually, a broken chain.



To adjust the depth gauge place the filing gauge tool on a cutter. The tool will show you how much to file. Using the flat file, file the depth gauge level with the tool. After filing to proper depth, round off the front edge. A gauge that hasn't been properly rounded will hammer into the wood, and make the top-plate grab too large a bite. Loose rivets will result.



Lower and round off all gauges on the top of the bar, then move the chain around the bar, and continue filing until all depth gauges are lowered.

How often you need to sharpen a saw chain will depend on how much you use the saw and what you are cutting. When cutting a log on the ground, stop a safe distance from the dirt. Then roll the log to finish the cut. Dirt will damage your saw quickly. Remember, a sharp saw will feed itself into the wood, a dull one won't.

Chain saws can be kept in good working condition by correct sharpening. Check with your foreman or in the manual of your particular saw for other instructions on sharpening and maintenance. Knowing when and how to sharpen your saw means the saw will be more efficient.

KEY POINTS TO REMEMBER

- CHECK CHAIN TENSION.
- ALWAYS WEAR GLOVES WHEN HANDLING THE CHAIN.
- USE THE RIGHT SIZE SHARPENING TOOLS.
- ALWAYS FILE FROM THE INSIDE TO THE OUTSIDE OF THE CUTTERS.
- APPLY PRESSURE ONLY ON THE FORWARD STROKE.
- USE THE SAME NUMBER OF STROKES AND THE SAME PRESSURE ON EACH CUTTER.
- ALWAYS CHECK THE DEPTH GAUGES.

General Occupational Safety and Health Regulations
Chain Saw Sharpening

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Flammable and Combustible Liquids	29CFR 1926.152
Power Operated Hand Tools	29CFR 1926.302
Tools - Hand and Power, General Requirements	29CFR 1926.300

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts.

Laborers-AGC Education and Training Fund wishes to thank the following for their help in revising this manual:

Leonard Butts, Laborers Training & Retraining Trust Fund for Northern California.
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SECTION V-b
ELECTRIC TOOLS

Whenever you use an electrical tool you should wear eye protection and hearing protection also. Inspect the electric tool before taking it to the work area. Check cords, starter switches, and protective guards. Plug in the tool to see if it is working properly. Do not use a tool that is overheating, vibrating, arcing at the brushes, or emitting electrical tingles of any sort. Every extension cord used with a power tool must have the proper wire gauge. The gauge number of the wire depends on the number of amps that it takes to run the power tool and the length of the cord. (Figure)

Any three prong plug should have the ground pin intact. Never bend back or cut off the ground pin on a three-prong plug and never use an adapter to change the plug from a three-prong to a two-prong plug.

Many of the newer power tools do not have a 3 prong plug. They are double insulated, so the cord only has a two-prong plug. Some work sites make it mandatory for workers to use ground fault circuit interruptors when working with electrical equipment. A GFI detects any leaking current really quickly and shuts off the power supply, preventing the user from getting shocked. (Figure) Connections inside the plug are loosened and the cord is damaged if the cord is used to jerk the plug out of the socket or if the tool is carried by the cord. Check all cords for kinks, cuts and cracks. Keep cords and electric tools stored away from water or oil. Loop cords together rather than knotting them.

Electric Hand Drill

The electric hand drill is used on wood, metal and other types of material. Since hand drills come in a number of types and sizes, they can be fitted with many different attachments that can sand, grind, saw holes and drive screws. Speed bits and hole saws are two attachment examples.

The most commonly sized drills are the 3/8" and the 1/2" drill. The size of the drill is determined by the maximum chuck opening. So a 1/2" drill would open up to a maximum of half an inch. Variable speed drills turn faster as you squeeze harder on the trigger. The tip of drill bits should be at about 59 degrees from the vertical. If there is not enough of a point on the bit, extra pressure is put on the tip, causing it to break. Use a drilling lubricant to cool down the drill bit so that they last longer. Unplug the drill bit when you have to remove or change it.

Hammer Drill/Rotary Hammer

This tool will chip, drill, break pavement and set anchors. The rotary hammer will drill into concrete, masonry, and other building materials quickly. Hammer drill bits must be sent to the manufacturer for expert resharpening.

Skill Saw/Circular Saw

Any material cut with the skill saw must be placed with the good side down so that any splinters formed will be opposite the good side. Only place enough force on the saw to move it along the cut. Forcing the saw through knots and tough cuts will create inaccurate cuts, while overheating the motor and the blade.

An upper guard should cover the whole saw blade and a retractable lower guard should always be working to protect the user. If the lower guard does not return to its original position the skill saw should be tagged out for repair.Blades should be sharpened by a qualified person. If the blade is kept sharp at all times it is less likely that the saw will kick back at the operator. The speed marked on the blade should be at least as high as the no load RPM on the nameplate that is found on the saw. The proper type of blade should be chosen for the job. Never issue a bent, broken or warped saw blade. If the blade is blue it has been over-heated and should be discarded. Sometimes blades overheat when they are not cleaned properly, especially after sap has built up on the blade. Make sure that the arbor hole is the proper size and that the washers are properly installed on the saw so that the blade is well secured. When the blade is installed the arrow on it should be pointed in the same direction as the arrow on the saw.The crosscut blade is designed to cut the cross-grain in wood and the ripsaw blade cuts the long grain. The combination blade can be used for crosscutting, ripping, and cutting plywood. The standard combination is used by trim carpenters.Carbide tipped blades have teeth that stay sharper for longer periods of time. When a carbide tipped blade is returned to the tool crib double-check the tips on them because they have a tendency to come loose when they hit nails or metal. If the blades have any loose carbide tips, the tips can fly off and injure the operator.

Portable Band Saws

Bandsaws have endless, circular blades that come in different sizes. The brand names you are most likely to see in the field are Greenlee and Ridgid bandsaws.

Portable Jigsaw

The jigsaw or sabre saw is used to cut inside or outside curves. It generally has 7 to 32 teeth per inch on the cutting blades. For all-around work, a blade that has 10 teeth per inch is the best to use. To make any rough cuts a blade with 7 teeth per inch will cut the fastest.

Reciprocating Saw

The reciprocating saw holds a larger, heavier duty blade than the jigsaw. It is most often used to cut holes in ceilings and walls. It can cut through metal or wood.

On the Milwaukee Super Sawzall the blade must be at least 3-1/2 inches long, so you should check whatever model of saw you have in your tool crib, to make sure that you issue the proper sized blade. As a general rule the following blades are used on most reciprocating saws:

Recommended for Cutting	Teeth Per Inch
Wood	4 - 8
All purpose	8 - 14
Metal	14 - 24

To remove the blade on a Sawzall, a hex key is used to turn the blade clamp screw counterclockwise, 2 full turns.

A new blade can be put into the Sawzall with the teeth facing either upward or downward. You have to push the blade all the way in to install it. Once this is done, you can then turn the hex key clockwise until it is tightened down.

The operating speed on the grinding disc must be at least as great or greater than the operating speed of the angle grinder.

The grinding or cutting disc will explode if it turns at a faster speed than it was intended to turn. The disc may also disintegrate if it is cracked or chipped. A disc can be tested further for unseen hairline cracks, even after a visual inspection does not turn up anything. Just take a non-metallic device (like a plastic screwdriver handle, for instance) and gently tap the disc while you hold it close to your ear. You will hear a clear metallic tone or "ring." Never drop, throw, or mishandle grinding or cutting discs because they are easily cracked. Check to see if the proper wheel has been issued. Some jobs may take a stainless steel disc. If the wrong disc is given to a worker to use, the disc will "glaze" and extra pressure will have to be placed on the disc, causing it to shatter.

If you ever have to install a new disc onto the angle grinder, you should run the angle grinder with the wheel installed for at least one minute. During this time you should be checking for wobbling or flutter of the wheel as it is turning. If you perform this test each time you install a new disc you should be able to tell if disc is installed properly or not. Make sure that the tool is unplugged during installation.

The angle grinder may begin to spark if the carbon brushes wear down to less than 6 millimetres. If this is the case, both brushes should be replaced immediately.

The manufacturer warns that it will be hazardous to use other accessories on the angle grinder, other than the ones that are recommended.

The accessories for a 5" angle grinder are different than for the larger 7" grinder and the smaller 5" grinder. There is also one other small but very important difference between the two grinders. The discs on the 5" grinder have to be installed with two wrenches. In order to install the disc you will need a lock nut wrench to tighten the lock nut, and you will also need regular wrench to hold the disc in place.

On the 7" grinder, only one wrench is needed because when a button is pushed in on the housing of the grinder, the disc is locked into place.

Goggles and full face shields should be used to protect the eyes, especially when wire wheels are issued. Wire wheels also come in stainless steel.

Portable Bender

The electrically operated portable bender can bend a variety of pipe or conduit.

Shears and Nibblers

Almost anybody who needs to cut metal will need to use shears and nibblers at some time or another.

Electric shears cut like a pair of scissors. They can cut curves and straight lines in a shorter time than nibblers. Nibblers can cut heavier metals than the shears. You may see electric or air operated nibblers that will cut without any metal distortion because they punch out small rectangular pieces of metal at high speed.

SECTION V-c
PNEUMATIC TOOLS

Pneumatic tools are powered by compressed air. Tools like chippers, drills, hammers, and sanders can all be run on compressed air.

Airlines are used to get the compressed air to the tool. Airlines should be checked for cuts, or worn out spots that could cause the line to bulge or weaken in any way. Before airlines are stored any moisture should be blown out, otherwise that moisture will get into the air tool and affect the way it runs. Oilers should be used in the air line so that the air tool is lubricated. Ether can be added to the line in the winter time to keep the air tool from freezing up.

Impact Tools

A safety clip or retainer is used on chipping hammers, jack-hammers, and other impact tools, to hold the bit in place. There are several different types of retainers. Some of the retainers you may come across are; knurled screw-on collar, spring clip, spring insert lock, or a heavy steel tension spring.

It is very important for you to check to see that the retainer is working, otherwise the bit can be shot out of the barrel. It is also a good idea to provide a full face shield whenever someone signs out a chipper or a jack hammer.

Any air tool that you sign out must be inspected for loose parts. This especially applies to hammering tools like pavement breakers.

The control valve trigger is important because when it is not being held down, it returns to its' original position. This safety device is important because the impact tool will not operate unless the worker wants it to operate.

Pavement Breaker

The larger type of pavement breaker can create quite a lot of fatigue. To reduce the strain, pain and vibration fatigue, large, heavy duty rubber hand holds are put on their handles. Every tool is designed to make the job easier and safer for the user. Something like a rubber hand hold may seem unimportant but it is important when you stop to think about it for a while.The 65 and the 90 pound pavement breaker should be checked pretty thoroughly before they are signed out. Make sure that the air inlet is plugged with a rag to keep dirt and any other foreign matter out of the breaker. The back head nuts at the top of the breaker should be tightened evenly.

The side rod springs should be tight enough so that the spring cannot be moved by hand but the springs should not be so tight that spring coils are not touching each other. The retainer latch nut should also be tightened down because it holds the gads, cutters, spaders and chisels in place.

Each of these breaker accessories should be checked for sharpness and the bit should also be put into the breaker before the breaker is signed out.

Just as an example, if you took a chisel and it would not go into the breaker or after putting it into the breaker the chisel turned freely, you would know that the chisel did not have the correct hex size. If the chisel did not turn and you had no play you would know that you had the right chisel size.

Line oilers are a very important part of the air tool system because they are used to keep the air tool lubricated. It is recommended the oiler is placed about 10 feet from the gun.

Oilers have an adjusting screw that controls the flow of oil to the gun. It is easy to tell when the gun is getting enough oil because there will be a little bit of oil showing on the shank of the tool and a fine mist of spray will be coming out of the exhaust port. The gun is getting too much oil if the oil is coming out of the exhaust port, or if the oil is running down the tool. Another way to tell if you are getting too much oil, is if there is blue smoke coming out of the exhaust port.

Air lines are another important part of the air tool system. They should be rolled up neatly so that they are easy to handle when you issue them. One way to ensure that the hoses are rolled up neatly, is to take an unused 45 gallon drum, place it on a flat surface and wrap the hose tightly around the outside of the drum.

After this is done, you can tie the hose up in 2 or 3 places, with rebar wire. Whenever anyone comes to the tool crib for a hose you should also give them an extra gasket. If it is a common site practise that oilers are used on the job, then it would be a very good idea for you to have a separate bunch of 10 foot air lines ready to go in the tool crib.

Impact Wrench

Air powered impact-wrenches are more common in construction than the electrically run impact wrenches. A replacement like a soft pin, wire, or nail should never be used to hold the socket onto the square spindle of the impact wrench. The bearing should be greased after 40 to 60 hours of operation.

If there is no oiler in the air line, then the oil plug should be removed and a few drops of oil should be placed into the impact wrench. The oil in the housing of the impact unit should be checked on a monthly basis. The housing should be filled half-way, which is usually a maximum of two ounces of SAE #30 oil.

Most air wrenches should be run with 90 pounds of air pressure. If they are operated under more air pressure than that, the tool will be damaged. These air wrenches usually have a screen that keeps any foreign matter from getting into the gun. This screen should be checked and cleaned periodically. If the screen gets plugged up the gun will lose power. If the gun still loses power, it may be dirty on the inside. If this is the case, the tool can be flushed with gum solvent oil or with equal amounts of SAE #10 oil, and kerosene mixed together. When the gun is operated to flush out the solvent you should remember to point the exhaust away from yourself, or others nearby. A dirty gun or a plugged screen may not always be the cause of the power loss. If too many accessories are used, at once, or if a cracked socket is used by accident, loss of power will occur.

Chipping Hammers

Scalers, caulking and beading tools are the lighter type of tools in this classification.

LABORERS-AGC TRAINING TIPS

No. 1

TRAINEE INFORMATION PROFILE SERIES

THE 90-POUND PAVEMENT BREAKER

The 90-Pound Pavement Breaker is an essential tool to laborers' work. The 90 is also a rugged tool, but it's not indestructible. To keep the breaker working right, to get the job done right and to make work easier for yourself, you must make certain procedures part of your regular routine.

This manual is designed as a supplement to the video "THE 90-POUND PAVEMENT BREAKER" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

PROTECT YOURSELF AND OTHERS

Before starting any job, make sure you have the right safety gear for the task your doing.

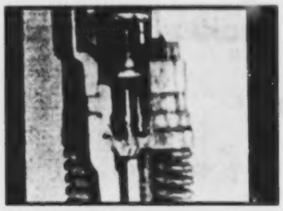
Working with the pavement breaker requires head protection, and that means wearing your hard hat. Other personal protective equipment needed: safety face shield or goggles, ear plugs, work gloves, safety-toed work shoes and respirator protection as required.

Your air hose is the lifeline to the breaker, but it can also threaten your life and others around you. When working with the 90, always be aware of the position of the hose; it can cause a tripping hazard. When you pull the hose to move it, make sure you have slack and that no one else can be caught in the line. Your connections must be tight and secured before you turn on the air line.

When blowing out the hose to remove dirt and moisture NEVER point it at anyone and don't point it at the ground. NEVER USE COMPRESSED AIR TO CLEAN YOURSELF OFF!

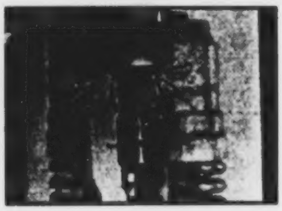
ONE RULE TO REMEMBER

The 90 is a precision-tooled machine, with close metal-to-metal tolerances. Twelve hundred times a minute, compressed air drives the piston up and down. The piston hits the tappet and the tappet hits the tool.



The piston, the tappet and the tool are the only metal parts that should hit against one another. They are designed to take this kind of impact.

Because of this "action" by the tool, you should always leave the gun off when the tool isn't pushing against work. If you don't, the wrong parts get hit. First, the front head housing gets hit by the tappet causing it to wear down. Once it's worn, the tappet bushing gets hit by the piston and the breaker loses punch and critical parts can wear out. Always test and bleed the gun against work.



When your breaking with the gun, leave it off when you move from one breaking point to another . . . even though the move takes "just a second."

NEVER OPERATE THE GUN WHEN IT'S NOT AGAINST WORK.

MAINTENANCE

Maintaining the breaker is an important part of your job. If the nuts and springs are not checked and adjusted, the gun will malfunction. This will lead to worn parts, lost punch, costly repairs and extra effort for you.

As a matter of routine you should check the back-head bolts. If they are loose, take up on the nuts evenly. Check the side-rod springs.

If you can turn the spring, the nut's too loose. Take up the nuts evenly, but not so tight that there's no space left between the coils of the spring. Be sure the retainer latch nut is tight, too, as part of your routine for checking the breaker.

KEEP THE GUN OILED

As stated earlier, inside the gun metal moves against metal twelve hundred times a minute. This movement causes intense heat and friction. In addition water from the air line can cause rust and pitting. Because of these conditions, equipment manufacturers recommend an oil that has properties to fight these problems and to make the gun work better. It's called rock-drill oil.

The properties of rock-drill oil differ from those of motor oil. Intense heat can break down motor oil more readily than rock-drill oil. Motor oil is less efficient in reducing friction, where rock-drill oil has a tackiness that makes it adhere to metal surfaces to overcome friction.

Unlike motor oil, rock-drill oil combines with water, so that all parts in the breaker will be oiled uniformly. Motor oil exhaust fumes can cause eye irritation and nausea in close quarters. The fumes from rock-drill oil are non toxic.

Line oilers are recommended by equipment manufacturers to keep the gun operating efficiently.

The oiler should be used about ten feet from the gun. If it's too far from the gun, the oil will reach the gun intermittently in drops and globs. At ten feet, the oiler feeds a steady, fine mist of oil to the gun, covering all working parts.

When using the oiler avoid getting dirt in it. Keep the feed screw properly adjusted so the right amount of oil gets to the breaker.

A fine mist of oil from the exhaust is a sign that the gun is getting the right amount of oil. You should also see a fine coat of oil on the tool.

Watch for these signs of over-oiling:

- oil running down the tool.
- blue smoke out of the exhaust.
- thick spray of oil out of exhaust.

When you don't have an oiler, use the oil reservoir in the 90. You'll have to fill it several times a day.

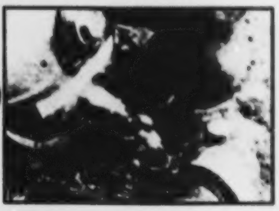
KEEP OUT DIRT

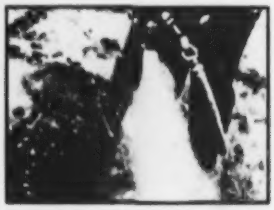
Just as "oil" is the gun's best friend, "dirt" is its worst enemy. Dirt and grit get in and around the parts causing scoring and wearing of precision parts and even choking the gun.

To keep dirt out always plug the air inlet and the ends of the line oiler with a clean rag. Coil and connect the hose and always lay the gun down in a clean area, never in dirt or sand.

Blow out the hose to remove dirt and moisture before you hook up the breaker to the line. Remember, NEVER point it at anyone and don't point it at the ground.

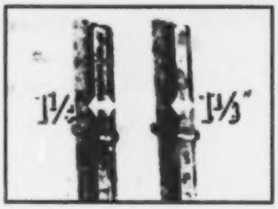
To clean the gun in the field, pour a few ounces of solvent in the air inlet. Run the gun against work until the solvent stops spraying out the exhaust.





Then, pour a little rock-drill oil in the air inlet and run the gun against work.

TOOLS: THE RIGHT SIZE AND IN GOOD CONDITION



Tools for the 90 pound pavement breaker come in two hex sizes, one and one-quarter inches (1 1/4"), and one and one-eighth inches (1 1/8"). **Your breaker will be made to take one or the other.** You can't put a one-and-a-quarter inch gad in a one-and-an-eighth-inch chuck. But you can make the mistake of putting a one-and-an-eighth-inch gad into a one-and-a-quarter-inch chuck. If you can turn the tool in the chuck, the tool's the wrong size or the chuck bushing in the gun is shot. The right size gad won't turn and there's no play.

You can operate your breaker with an undersized or worn tool in the chuck, but the steel chuck-bushing will be damaged and the tool will be getting hit at an angle. This could cause the gad to break and you're left holding 90 pounds of weight. The sudden jerk can throw you off balance and injure your back. Check the tools to be sure that they're sharp enough to do the work. If you use tools that are dull, you will take too long to do the job, wear out the gun and work against yourself.

A dull tool is also dangerous. It may slip and throw you off balance. Be sure the spare tools you take with you are also in good shape and are the right size for the breaker. If possible, check all tools before you go on the job. A worn tool or a tool that's too small for the breaker, puts extra strain on the breaker and on you.

KEY POINTS TO REMEMBER

- NEVER OPERATE THE GUN WHEN IT'S NOT AGAINST WORK.
- BE SURE THE NUTS AND SPRINGS ARE PROPERLY AND EVENLY ADJUSTED.
- KEEP THE GUN PROPERLY OILED.
- KEEP DIRT OUT OF THE GUN AND OUT OF THE HOSE.
- USE THE RIGHT SIZE TOOL FOR THE GUN AND BE SURE THEY'RE IN GOOD SHAPE.

General Occupational Safety and Health Regulations
90-Pound Pavement Breaker

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
Power Operated Hand Tools	29CFR 1926.302
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Occupational Noise Exposure	29CFR 1926.52
Gases, Vapors, Fumes, Dust and Mists	29CFR 1926.55

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts. Standards applying to the compressed air source are covered in Training TIPS #2

Laborers-AGC Education and Training Fund wishes to thank the following for their help in revising this manual:

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LABORERS-AGC TRAINING TIPS

No. 9

TRAINEE INFORMATION PROFILE SERIES

CHIPPING GUNS AND GRINDERS

Chipping guns and grinders are tools used frequently by laborers. The chipping gun is a lightweight tool, used to dress-up walls by removing bellies or rough edges in concrete caused by forms giving way during concrete pouring, to prepare walls for bonding and to pierce holes in concrete slabs for pipe or conduit.

This manual is designed as a supplement to the video "CHIPPING GUNS AND GRINDERS" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

Most chipping guns and some grinders operate on compressed air. Follow standard operation and maintenance procedures to insure compressed air tool safety. Clean, service and set the line oilers. Safety wire all connections and safely blow out hoses before you attach the tool and start work.

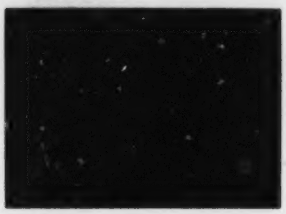
SAFETY FIRST

Safety equipment and procedures cannot be over-stressed. When you use a chipping gun, you must wear goggles, ear protection and gloves. A respirator is necessary if the conditions are dusty. Concrete dust can be extremely harmful to your lungs.

Flying chips can be dangerous to you and others around you. Be alert for workers entering your job area who aren't wearing goggles. If they are not wearing safety goggles, stop the chipping gun and warn them of the danger.

Never wear loose clothing, it can be snagged by the grinding wheel and injure you.

When working on scaffolding, raise and lower your tools with a rope or in a bucket. Never pick it up or lower it by the cord or hose, you can damage connections. Always tie off the hose or cord, leaving enough slack to work with, but leave it short enough so that if the tool falls, it won't fall to the ground.



Keep extra tools in a bucket so they can't roll off the scaffolding and injure fellow workers. Safety regulations require that grinders have a wheel guard. Never use the grinder without the guard. This helps protect you if the wheel shatters while you are grinding.

USING THE RIGHT TOOLS

Make sure you have the proper tools on hand to do the job. They should be in good shape and sharp. Remember, tools can overheat and break. Be sure to take along a spare.

The chipping tool has three basic heads.

- The chisel - it is used to chip concrete.
- The point - it is used to chip concrete.
- The bush head - it is used to rough-up concrete to prepare it for bonding and smooth out minor imperfections on a wall.

THE CHIPPING GUN

There are various types of chipping guns used. With the gun shown, insert the tool, put on the collar, then make sure the retaining spring or latch is locked in position This will prevent the tool from flying out of the chipping gun. Position the exhaust deflector so that exhaust is directed away from yourself. Test the gun against the work. A slight pressure is all that is needed to operate the chipping gun. Too much pressure is extra work for you and extra work for the gun.

When you are finished working, turn off the compressor valve. Bleed the hose with the gun against work, and then shut off the compressor and make sure it blows down. Coil and secure hoses. Disassemble the gun and clean it and the tool with a clean rag. Then plug the air inlet with a clean rag. Return tools to proper storage bins and report equipment that needs repair.

THE CONCRETE GRINDER

The picture shows an electrical concrete grinder. This grinder is used by laborers to smooth out high spots in concrete and to repair minor defects caused by form failures.

THE CONCRETE GRINDER

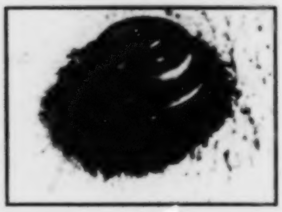
Most grinders, and some chipping guns, operate on electricity. Make sure you have enough heavy duty safety cord to reach from the power source to the work area. Then, check all cords and extensions for fraying, especially at connections. Damaged cords must be replaced or repaired before use. Use 3-wire cords and extensions, and never use a tool unless it is properly grounded. For the protection of the worker, Ground-fault circuit interrupters (GFCI) are required for all 120 -volt, single-phase, 15- and 20-ampere receptacle outlets that are not part of the permanent wiring of the structure on construction sites.

Make sure you have enough slack in the cord to work freely, and that the work area is free of debris. Remember, when working with electrical tools under damp conditions, always wear rubber boots. Air tools should be used when the operator must stand in water.

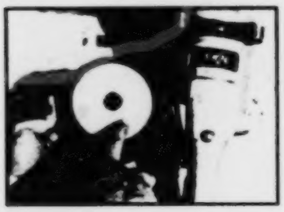
When you must chip or grind above the normal shoulder-high or head-high level for an extended period of time, use scaffolding.

GRINDER WHEELS

Grinder wheels vary. The most common for laborers are straight, cup and brush.

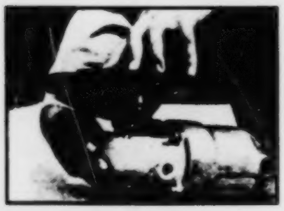


The one used most by laborers in the field is the cup wheel. It is a good idea to have an extra wheel on the job in case the one you're working with breaks. You should always check the RPM rating of the wheel and compare it to the RPM of the grinder. Only use wheels that have an RPM rating that is equal to or greater than the RPM of the grinder. **Never use a wheel that has a lower RPM rating.** If the RPM isn't marked on the wheel, check with your foreman to see if it's okay to use.



You must examine the wheel for cracks. Some manufacturers recommend the "ring" test. The ring test consists of tapping the wheel with a screwdriver handle. Give the wheel 1/4 turn and tap it again. Continue to do this until you have covered the whole wheel. If it has a hairline crack near one of these four places, you'll get a dull sound rather than a "ring". Before you start grinding concrete, put on your respirator. Remember, concrete dust can be extremely harmful to your lungs.

The grinding wheel should be installed before the cord is plugged in. This grinder has a locking button. Push the button in so you can spin the wheel on. The wheel on the grinder screws on in one direction and the grinder spins in the opposite direction. The wheel tightens itself when it is brought into contact with the work.



LET THE TOOL DO THE WORK

When the wheel and guard are properly installed, plug in the grinder. Make sure the cord gives you freedom to work and doesn't present a tripping hazard for you and any other worker.

Always start the grinder with the wheel facing away from you and fellow workers. Point it toward the ground. Test the grinder by letting it run for about a minute before you begin grinding. If the wheel is defective, this is when it may come apart.

When you are sure that the wheel and grinder are okay, begin grinding. As you're operating the grinder, smooth contact should be made, avoiding bumping. Do not exert excess pressure; this could damage the wheel. Let the tool do the work. The use of a steady back-and-forth motion enables you to cover a wider area. If the wheel should begin to rotate unevenly at any time, it may mean the bearings are worn. Report this to your foreman. Do not attempt to use the grinder.

Electric grinders are operated by squeezing a trigger. Grinders with wheels more than 2" in diameter can have a throttle locking control. You must be able to turn the lock off by a single motion of the same finger(s) that turned it on. As you are finishing, stop the grinder against the work so the wheel will be stopped when the machine is set down.

When working with the grinder, an important point to remember is to never raise or lower the grinder by the cord, especially from scaffolding. This can cause the electrical wires to pull loose from the motor.

It's also important not to drop or bump the grinder. This can cause damage to the wheel, shaft, housing and guard.

The grinder should never be set in oil or grease. The wheel can absorb these and be thrown out of balance.

Some grinders have a cradle on it so when you lay it down it remains upright. If you have to leave the work area for a short time, unplug the grinder. This prevents accidental starting of the grinder.

In preparation for shutting down, the cords should be coiled, tied and plugged. The wheel should then be removed and the grinder should be wiped off with a clean rag.

Return the grinder, wheels and cord to the proper storage area and make sure the RPM on the wheel can be easily read.

Practice and develop your skills so you can become effective and work safely when usin chipping guns and grinders.

KEY POINTS TO REMEMBER

- ALWAYS USE PERSONAL PROTECTIVE EQUIPMENT.
- NEVER RAISE OR LOWER THE GUN OR GRINDER BY THE CORD.
- WHEN WORKING IN WATER WEAR RUBBER BOOTS OR USE AIR TOOLS.

CHIPPING GUN

- BEWARE OF FLYING CHIPS.
- ALWAYS TEST AND BLEED GUN AGAINST WORK.
- BE SURE TOOLS ARE IN GOOD CONDITION AND SHARP.
- APPLY SLIGHT PRESSURE WHEN USING THE GUN.

GRINDERS

- NEVER USE A WHEEL THAT HAS A LOWER RPM RATING THAN THE GRINDER.
- NEVER USE A GRINDER WITHOUT A GUARD.
- NEVER WEAR LOOSE CLOTHING.
- TEST ALL WHEELS BEFORE USE.
- WHEN TESTING THE GRINDER POINT IT AWAY FROM YOU AND OTHERS.
- LET THE TOOL DO THE WORK.

General Occupational Safety and Health Regulations
Chipping Guns and Grinders

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
Power Operated Hand Tools	29CFR 1926.302
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Occupational Noise Exposure	29CFR 1926.52
Gases, Vapors, Fumes, Dust and Mists	29CFR 1926.55
Tools - Hand and Power, General Requirements	29CFR 1926.300
Electrical - Safety Related Work Practices	29CFR 1926.416
Abrasive Wheel and Tools	29CFR 1926.303

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts.

Laborers-AGC Education and Training Fund wishes to thank the following for their help in revising this manual:

Leonard Butts, Laborers Training & Retraining Trust Fund for Northern California.
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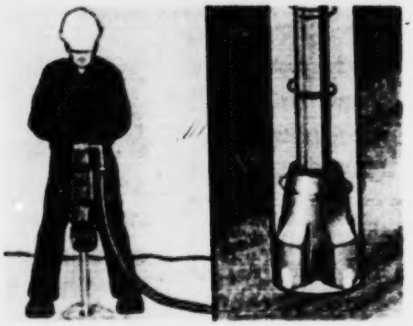
LABORERS-AGC TRAINING TIPS

No. 18

TRAINEE INFORMATION PROFILE SERIES

THE JACKHAMMER



The jackhammer is principally used in drilling boulders for secondary blasting, small outcroppings of hard rock for blasting in pipe trenches or building excavations, small ledges of rock for blasting where it is impossible to use an air track, dowel holes in concrete floors for new starter walls or building extensions and drilling holes for hydraulic rock and concrete splitters.

This manual is designed as a supplement to the video "THE JACKHAMMER" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. You should always follow the manufacturer's recommendation for the jackhammer you use. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

Before starting any job, make sure you have the right safety gear for the task you're doing.

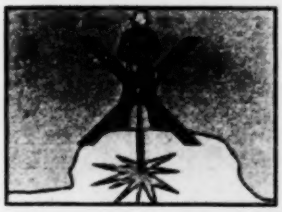
Safety First

Working with the jackhammer requires head protection, and that means wearing your hard hat. Other personal protective equipment needed: safety face shield or goggles, ear plugs, work gloves, safety-toed work shoes and respirator protection as required.

Your air hose is the lifeline to the drill, but it can also threaten your life and others around you. When working with the drill always be aware of the position of the hose, it can cause a tripping hazard. When you pull the hose to move it, make sure you have slack and that no one else can be caught in the line. Your connections must be tight and secured before you turn on the air line. Park the compressor upwind from the drilling to protect the radiator, but close enough so as to use as little air hose as possible to reach the drilling area.

Blow the air hose clean of dirt and moisture before you hook up the jackhammer. **When blowing out the hose NEVER point it at anyone and don't point it at the ground. NEVER USE COMPRESSED AIR TO CLEAN YOURSELF OFF!**

One Rule To Remember



The most important safety priority for a jackhammer driller is to **never drill into a hole left after a previous blast.**

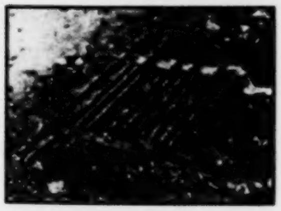
Keep It Oiled

Because of the intense force and heat generated by the jackhammer's operation, equipment manufacturers recommend an oil that has properties to fight these conditions. It's called rock-drill oil.

The properties of rock-drill oil differ from those of motor oil. Intense heat can break down motor oil more readily than rock-drill oil. Motor oil is less efficient in reducing friction, where rock-drill oil has a tackiness that makes it adhere to metal surfaces to overcome friction. Unlike motor oil, rock-drill oil combines with water, so that all parts in the breaker will be oiled uniformly. Motor oil exhaust fumes can cause eye irritation and nausea in close quarters. The fumes from rock-drill oil are non-toxic.

Line oilers are recommended by equipment manufacturers to keep the jackhammer operating efficiently.

When using the oiler keep it clean. Avoid getting dirt in it and properly adjust the feed screw so the right amount of oil gets to the breaker. The proper line oiler adjustment will result in a small amount of oil appearing on the shank of the steel while the jackhammer is operating. You should fill the line oiler at the start of the shift and check it during the shift



The Drill Steel

The drill steel that is used in jackhammer work comes in different sizes, generally two, four, six and eight foot lengths. The two foot steel is called the starter steel.

Drill steel is a precision tool and should be handled carefully. Use heat resistant grease on the threads.

The bit must be threaded up so that it is in solid contact with the end of the rod. The bit has to be sharp for effective drilling and to save effort on the part of the driller.

Tighten the side rod bolts on the drill by taking them up evenly. This should always be done before starting the shift.

Drill Procedures

Proper alignment of the drill is the most important priority in effective drilling and is also an important priority in jackhammer maintenance.

Mis-alignment puts the drill under unnecessary strain and parts can quickly wear out or break. Correct alignment is the art of drilling the hole on a line plumb to the plane of the drilling surface.

In jackhammer drilling, starting the hole or "collaring" is a key to correct alignment. SAFETY TIP: The driller always wears safety glasses when collaring or drilling.

The starter steel is attached to the drill and with the bit between the drillers feet. SAFETY TIP: Angle your shoes to form a pocket so the turning drill does not damage your shoes.

You should hold the drill with both hands in correct alignment or perpendicular to the drilling plane and exert only enough pressure on the drill to keep the bit against the work.

Remember to keep the throttle at less thar half open until the hole is "collared", that is, deep enough that correct alignment is established.

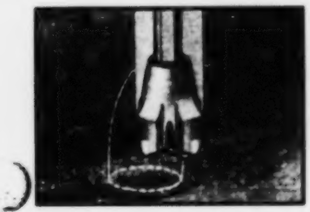
Then move your feet away from the steel, open the throttle and drill the length of the starter steel, blowing the hole frequently to keep it clean of drill cuttings.

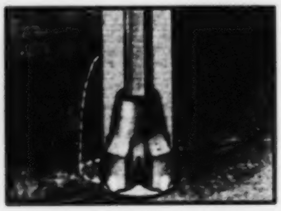
When the starter steel is drilled out, it is taken from the hole and the four-foot steel is placed in the hole. Usually this steel as well as the other lengths has its own bit.

Each of the bits on the lengths of steel has to be of the same size or successfully smaller. If a larger bit is used the steel will bind in the hole.

From two feet down, the hole should be blown free of cuttings every few inches and the bit should be lifted up and down in the hole to make sure it's running free and that alignment is being maintained.

If the bit tends to bind, re-drill that section of the hole. Then, true the drill, cut down on the throttle, and "re-collar" the hole.



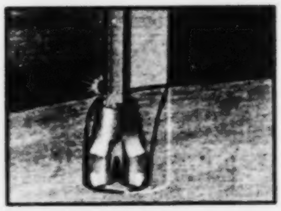


Be careful that you only exert enough pressure on the drill handles to keep the bit against the work and to prevent bouncing of steel.

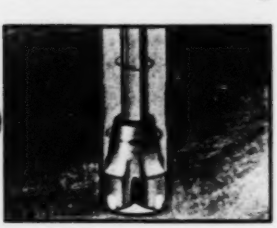
The drill should blow cuttings freely--if it doesn't pull the steel and clean the bit.

If you're drilling in a ledge of rock and you hit a mud seam, the bit has to be "re-collared" in the hole or the bit will drift and alignment will be lost.

The same is true if your bit hits another strata of rock--the bit will drift and if the new strata is not "collared" the steel will bind in the hole.



Be careful drilling in ledges containing moist formations--a "mud collar" can build up behind the bit and result in a stuck steel.

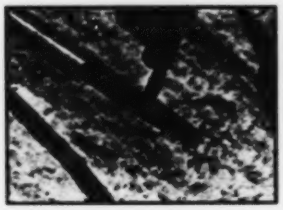


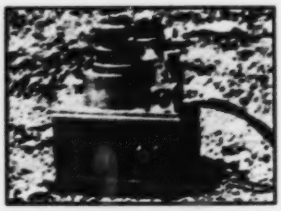
You can prevent "mud collaring" by making sure the drill is blowing cuttings every few inches. Also check the hole for bind by lifting the bit up and down in the hole every few inches of drilling. This way if a "mud collar" starts to build up it can be discovered and drilled out before it's too late.

When finished, protect the hole you've drilled by plugging it with wadded paper.

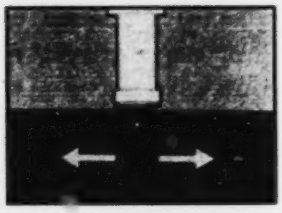
Hydraulic Rock Splitter

The hydraulic rock splitter is used to break either rock or concrete. It consists of a splitting cylinder containing one plug and two feathers and a hydraulic power unit.





The different rock breaker models exert from 209 to 410 tons of splitting pressure. As the plug advances under hydraulic pressure the two feathers are forced against the walls of the hole.

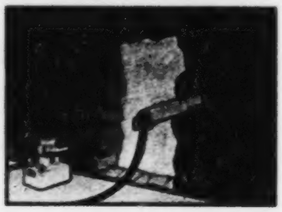


The most important safety priority while using the rock splitter is to watch for moving rock. A rock with a round bottom can roll after splitting in half.

The correct drilling of holes with the jackhammer is crucial to effective rock splitting and protection of the splitting tool. The following should be followed:

- Holes have to be drilled perpendicular to a breaking surface.
- Holes have to be drilled the correct diameter for the size rock breaker to be used.
- Holes have to be straight to the perpendicular surface (correctly aligned) and be the correct depth or the plug and feather assembly can be broken.

In breaking openings for concrete walls, a "point of give" is made by drilling a series of holes close together and breaking to these holes. Continue drilling and breaking larger pieces to the "point of give" until the line holes are drilled and broken out.



KEY POINTS TO REMEMBER

- NEVER DRILL INTO A HOLE LEFT AFTER A PREVIOUS BLAST.
- ESTABLISH AND MAINTAIN CORRECT ALIGNMENT.
- WATCH YOUR FOOTING AT ALL TIMES-ESPECIALLY ON BOULDERS.
- KEEP THE DRILL PROPERLY OILED.
- KEEP DIRT OUT OF THE GUN AND OUT OF THE HOSE.

General Occupational Safety and Health Regulations
The Jackhammer

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
Power Operated Hand Tools	29CFR 1926.302
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Occupational Noise Exposure	29CFR 1926.52
Gases, Vapors, Fumes, Dust and Mists	29CFR 1926.55

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts. Standards applying to the compressed air source are covered in Training TIPS #2

Laborers-AGC Education and Training Fund wishes to thank the following for their help in revising this manual:

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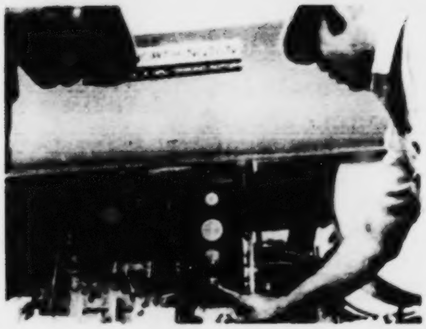
LABORERS-AGC TRAINING TIPS

No. 2

TRAINEE INFORMATION PROFILE SERIES

COMPRESSOR: OPERATION, MAINTENANCE AND SAFETY



This manual is designed as a supplement to the video "COMPRESSOR: OPERATION, MAINTENANCE AND SAFETY" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

THE COMPRESSOR

The portable air compressor provides power that is safe, economical and dependable for a wide variety of tools you'll be using on the job. Including: Pavement breakers, Jackhammers, Sandblasters, Tampers, Scabblers, Earth borers, Bore motors, and underground piercing tools.

Engines for the small portable compressors are either gas, diesel, or electric. The compressor itself is either a piston reciprocating type, or a rotary type--a rotary screw or a rotary vane.

Compressors are classified by the amount of air they put out-expressed in cubic feet per minute. A 125 compressor puts out 125 cubic feet of air per minute. A 150 compressor puts out 150 cubic feet of air per minute.

Your labor foreman will brief you on the safe and proper use of different types of compressors and explain the routine for servicing the compressor before you start it. He'll tell you how to check the battery, and the water. And he'll explain what hot and cold weather operating precautions to follow. Your labor foreman will tell you what kind of fuel and oil the compressor takes and where they're stored in the yard.

CHECK IT OUT

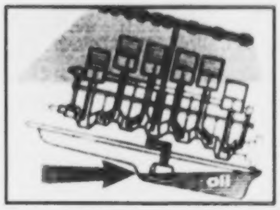
When you add oil to the crankcase, double check that you're using the right oil. Don't mix oils. And never over-fill the crankcase.

When you add oil to a rotary receiver tank, check that you have the right oil. And don't mix oils. Double check that you use the right fuel. Put gas in a gas engine, and diesel fuel in a diesel engine. An engine can be ruined by the wrong fuel or it just won't operate. Never run a diesel engine out of fuel.

Check and clean the air cleaners for the engine and for the air compressor, if this is part of the job given you by your labor foreman.

START UP

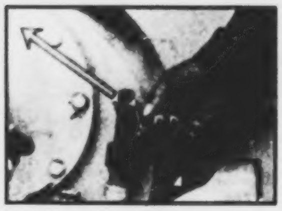
Make sure the compressor is level before starting it up. An adjustable caster-wheel on some units helps in leveling. The unit should not be operated if it's off level. When the unit is off level, the oil stays level and the oil pump intake won't function properly. The compressor can be damaged if it's operated in this position. Many newer compressors won't start if they're more than 17 to 20 degrees off level in any direction.



After you've leveled the compressor, follow your labor foreman's instructions, for starting it up, and let the compressor warm up. On some compressors crack the air valve about one-quarter open to take the load off the unit while it's warming up.

Check the oil gauge to make sure the engine's holding, the correct oil pressure. Check for leaks in the oil lines, or fuel lines, and in the radiator and hoses.

Close the air valve after the compressor's warmed up, and check the air gauge. The air pressure's pre-set for between 80 and 100 psi (pounds per square inch). Never try to adjust the air pressure regulator. It's a job for a mechanic. Check the pop-safety valve, a device required by law. It should never be wired down. It prevents the air receiver tank from becoming over-pressurized and blowing up.. Pull on the lever of the pop-safety valve. Air should blow out. If air doesn't escape, the compressor's unsafe and unlawful to operate. Report the condition immediately. If the unit's operating OK, hook up the hoses, making sure the rubber hose gaskets are in place, and secure them safely.



The compressor may fail to operate properly during the day, so be alert. Shut it off if the radiator boils, if the pressure drops, or if the compressor just doesn't sound right and check it out. When oil pressure gets dangerously low, or when the unit overheats, many compressors, shut off automatically. Re-start switches may have to be re-set manually before the unit will start up again.

If you add fuel during the shift, be safe; make sure the engine is off. Use a fuel can that has a filter to keep dirt out of the tank. If you add fluid to the battery during the shift, be safe; do it with the engine off.

SHUT DOWN

Close the air valve before you shut off a compressor that's been operating for a while, so the compressor engine can operate unloaded for a few minutes. This allows the unit to run cool and prevents damage to the compressor. When you shut the compressor off, the air receiver tank must be emptied.

Newer rotary compressors blow the air out of the air receiver tank automatically when the engine is shut off. Older and piston-type compressors are blown-down manually, by opening the air valve.

When you shut off a compressor that has an automatic blow-down device, and the device fails to work, you have to blow down the compressor manually, by carefully cracking the air valve. Never open the air valve full on, or you can damage

this type of compressor. Whenever you blow the air tank, or the air line, do it safely--be sure the air isn't blown at anyone, or blown so that it raises dust and debris. Compressed air and air-blown debris can be dangerous.

After the compressor's been shut off, open the drain at the bottom of the air receiver tank to drain off all the water that has accumulated during the day's operation. Remember, if you're using a rotary-type compressor it has oil in the air receiver tank. As soon as the oil starts to flow, after the water's drained off, shut off the valve.

If you had any problems with the compressor during the day, if it failed to blow-down or if you had to shut it down and service it for any reason, report the incident to your labor foreman. And whenever you have any questions about servicing or operating the compressor, ask your labor foreman.

TRANSPORTING AND SPOTTING

Transporting and spotting the portable compressor may be part of your responsibility.

When you're hooking up the compressor to the pick-up, both should be on the same level. Back up the pick-up slowly, close enough to make the connection.

When you're giving hand signals, play it safe; stand clear so you don't get caught in the bight between the pick-up and the compressor hitch.

Unblock the wheels, and keep the blocks with the compressor so you'll have them when you park the unit. Raise the kick-stand or caster-wheel, and be sure it's secure. Jockey the compressor hitch into position to make the connection. Whenever you're hooking up the compressor, unhooking it, or jockeying it around, keep it balanced. That's the only way to keep it safely under control.

Whether you're using a pintle-type (bolt and eye) connection, or a ball type, double check that the connection is safe and secure. Hook up the safety chain between the compressor and the pick-up. One end of the chain should be permanently mounted to the compressor draw-bar. Tie the other end of the chain around the bumper or draw-bar of the pick-up. Be sure to leave enough slack to prevent binding when the pick-up makes a turn.

Tie the loose end of the chain back on itself with half-hitches. Keep the end of the chain secured with a nut and bolt that's rigged with washers to keep the bolt in the chain.

Whenever you're towing, a strong safety chain is a must. If the hitch fails, the chain gives you time to bring the compressor to a safe stop. When you're towing, be extra careful: in passing, in following, in stopping. And be sure you observe the local speed regulations for towing.

When you arrive at the job site, if it's your responsibility to spot the compressor, spot it where it will be level, and where you'll have to make the fewest number of moves. Remember, you may have to move it by hand. If you can, park the compressor upwind with the radiator facing away from the work area, so dust and dirt won't be drawn into the radiator. When you're sandblasting, it's vital, to park the compressor upwind, and far enough away that sand doesn't get into the unit.

Operating, servicing, and handling the portable air compressor can be safe and simple, if you learn the correct procedures from your labor foreman, and follow them as a matter of routine.

KEY POINTS TO REMEMBER

- BE SURE NOT TO MIX OILS.
- NEVER OVERFILL THE CRANKCASE.
- KEEP THE COMPRESSOR LEVEL.
- NEVER ADJUST THE AIR PRESSURE REGULATOR.
- ALWAYS CHECK THE POP-SAFETY VALVE.
- ADD FUEL WHEN ENGINE IS OFF.
- USE A SAFETY CHAIN TO SECURE THE COMPRESSOR WHEN TRANSPORTING.
- SET COMPRESSOR UPWIND WITH RADIATOR FACING AWAY FROM WORK.

General Occupational Safety and Health Regulations
Compressor: Operation, Maintenance And Safety

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Power Operated Hand Tools	29CFR 1926.302
Occupational Noise Exposure	29CFR 1926.52
Flammable and Combustible Liquids	29CFR 1926.152
Fire Protection	29CFR 1926.150
Fire Prevention	29CFR 1926.151
Electrical - General Requirements	29CFR 1926.403
Battery Locations and Battery Charging	29CFR 1926.441

CAUTION: These air compressors may not be used to provide breathing air to supplied air respirators.

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts.

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POWDER ACTUATED TOOLS

Introduction

A Powder Actuated Tool is a tool that uses exploding gun powder to propel a fastener into concrete or steel. The energy from a powder load is transferred to a piston and the piston then pushes the fastener along a fastener guide. (Figure 5-1) Finally, the fastener is driven into the concrete or steel. This system is convenient since it carries its' own power source. At the end of this training section you will be able to perform a low velocity fastening operation safely and confidently, and take apart each of these tools and clean them correctly. You will also learn how to select different colored or numbered cartridges depending on how much you would like to penetrate the base material. You will also be able to recognize worn and damaged parts and whether or not the tool is operating properly. You will understand all the system components (Figure 5-2) which consist of the following:

- Tool
- Fastener (Pin)
- Cartridge (Powder Load)

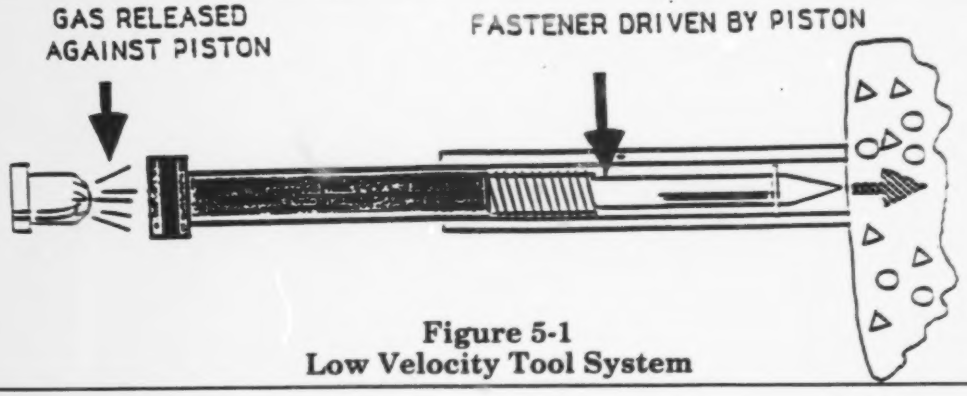


Figure 5-1
Low Velocity Tool System

Since all of the parts listed above are part of a system it is very important never to mix and match powder loads and fasteners supplied by different manufacturers. For example, you would never put an Omark fastener into a Hilti tool.

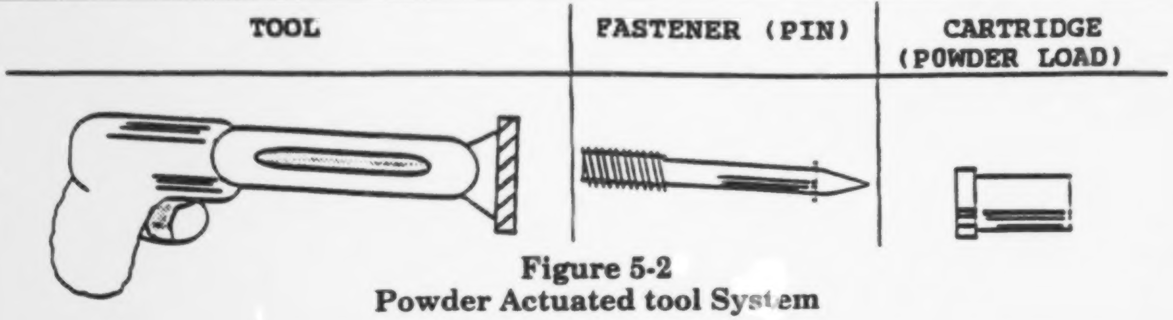


Figure 5-2
Powder Actuated tool System

Low Velocity Tool

The piston that pushes on the fastener of a low velocity tool travels much slower than the piston on a high velocity tool. The low velocity fastener enters the base material at a slower rate, so there is little chance for the fastener to ricochet or for the base material to shatter. In fact, the high velocity tools have a special guard or protective foot at the end of the tool to protect the operator from ricocheting fasteners and shattering materials. High velocity tools are less common today than in the past because they are not as safe as low velocity tools. The Hilti system operates on the low velocity principle.

Summary Questions

1. How does a powder actuated tool work?

2. Fasteners are driven into which 2 base materials?

3. Are you allowed to mix different tool components from one manufacturer to another?

4. Where is the energy from a powder load transferred when a low velocity tool is fired?

Fastening Applications

Powder actuated tools are used for many different fastening purposes. Powder actuated tools can be used in a wide variety of situations:

- duct straps
- partitions
- windows
- roof flashing
- light fixtures
- duct suspension
- conduit straps
- wall ties
- wood sleepers

You will learn about the Hilti DX450 and the DX36M low velocity fastening systems in this section. Any powder actuated tool system is designed to hold "dead loads" in place. A stable, stationary load is a dead load. Any load that vibrates or moves, even from something as slight as wind movement, is considered to be a live load. These loads are not designed to be fastened with a powder actuated tool.

Summary Questions

1. What special device can be found on a high velocity tool that makes it different looking than a low velocity tool?

2. Name 4 applications where a powder actuated tool can be used?

3. Is the Hilti DX36M and the DX450, high or low velocity?

4) What type of loads does the Hilti DX36M and the DX450 hold in place?

Firing The Tool

A Hilti DX450 and DX36M cannot be fired unless the muzzle or front of the tool is placed at right angles to the surface, 5 or more foot-pounds of pressure is placed on the tool and the trigger is pulled. These tools are designed this way so that they will not fire when they are dropped.

Power Level

An adjusting dial is found on the Hilti powder actuated tool that controls the impact power on the fastener, to a certain degree. The adjusting dial helps to make different power selections without having to change the powder load. (Figure 5-3)

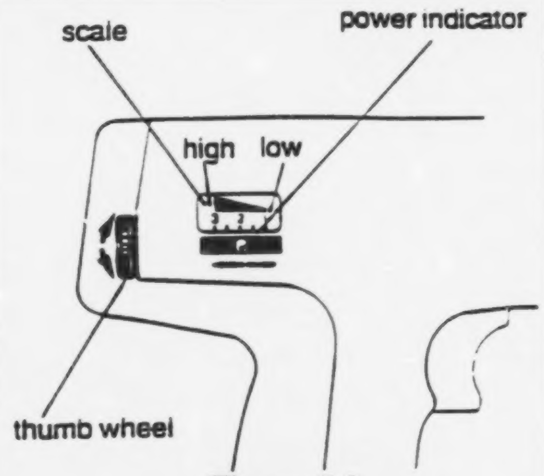


Figure 5-3
Power Regulator

Powder Load

The low velocity powder load or cartridge can be easily recognized since it has a crimped shell or casing. This casing is surrounded by a plastic molding. The plastic molding holds the case in place after the tool is discharged. This way, the casing can be removed along with the plastic molding. Another way to identify a low velocity cartridge is by the brass casing that holds the powder in place.

Table 5-1
Powder Load Strength And Color

Load Number	Cartridge Case	Powder Load	Tool Color Type
1	Brass	Gray	Low velocity
2	Brass	Brown	Low velocity
3	Brass	Green	Low velocity
4	Brass	Yellow	Low velocity
5	Brass	Red	Low velocity
6	Brass	Purple	Low velocity
7	Nickel	Gray	High velocity
8	Nickel	Brown	High velocity
9	Nickel	Green	High velocity
10	Nickel	Yellow	High velocity
11	Nickel	Red	High velocity
12	Nickel	Purple	High velocity

Powder Load Strength and Color

All low velocity and high velocity tools have different load strength numbers that range from 1 - 12. As the number increases, so does the strength of the load. Take a long look at Table 5-1. You will notice by the table that each number is matched with a color. Each cartridge carton shall be identified by color and matching number. Never use a high velocity cartridge in a low velocity tool or vice versa. Did you notice that the colors in the table repeat? You can never assume that the color on the cartridge will, in itself, determine if it belongs in a low or high velocity tool. You must look at the load strength number on the carton, the color of the cartridge and the identifying characteristics of the cartridge. For example; a red cartridge could be high or low velocity. It can be identified as a low velocity cartridge if it has a crimped, brass casing, the number 5 is on the cartridge box and if the cartridge is red.

Summary Questions

1. How do you hold a Hilti tool against the work surface in order to make it fire?

2. What is the purpose of the power level setting?

3. Give on example of a high velocity powder load? Name the number, color and the type of casing?

4. Give on example of a low velocity powder load? Name the number, color and the type of casing?

5. What is the load strength range, in numbers, for all powder loads?

6. What is the load strength range, in numbers and colors, for low velocity tools?

7. What is the color of a number 5 powder load?

Fasteners

Powder actuated tool fasteners are **not** common nails. Fasteners are made of tempered steel that is very hard, yet flexible. These special characteristics help the fasteners to penetrate concrete or steel without breaking. The shank of each fastener has a guide member attached to it. The guide member may be a washer, eyelet, or plastic guide, or some other type of guide, depending on the manufacturer. (Figure 5-4) The guide member keeps the fastener straight, as it travels out of the end of the tool, so that it is driven into the base surface at right angles.

Fastener Type And Use

There are 3 different types of fasteners (Figure 5-5):

- Drive pins
- Threaded studs
- Eye pins

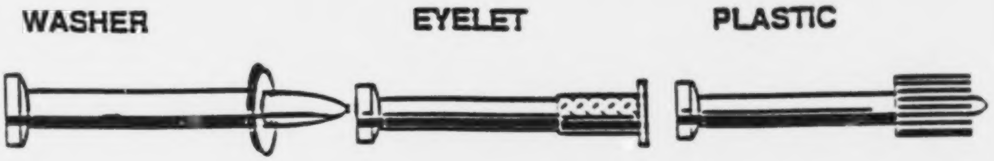
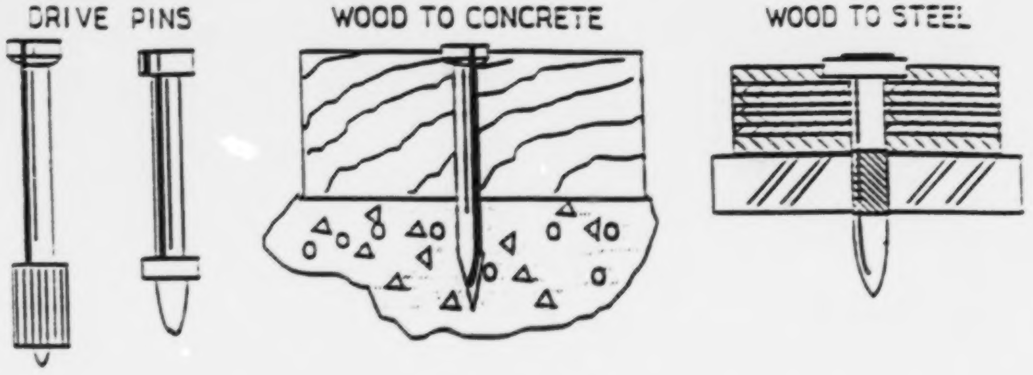
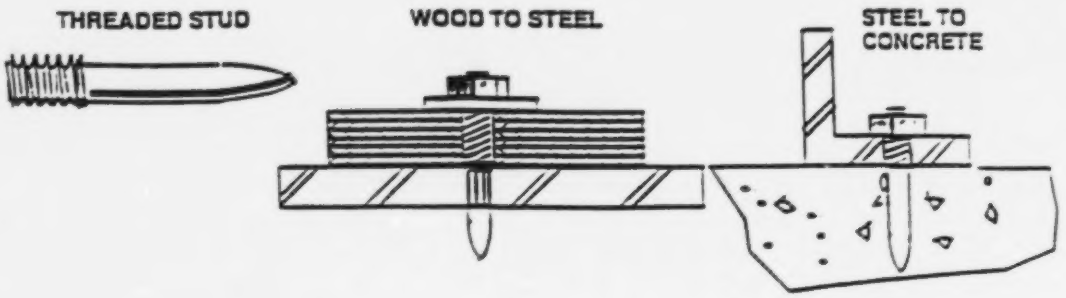


Figure 5-4
Guide Member Type

Drive Pins


DRIVE PINS
WOOD TO CONCRETE
WOOD TO STEEL

Threaded Stud


THREADED STUD
WOOD TO STEEL
STEEL TO CONCRETE

Eye Pin

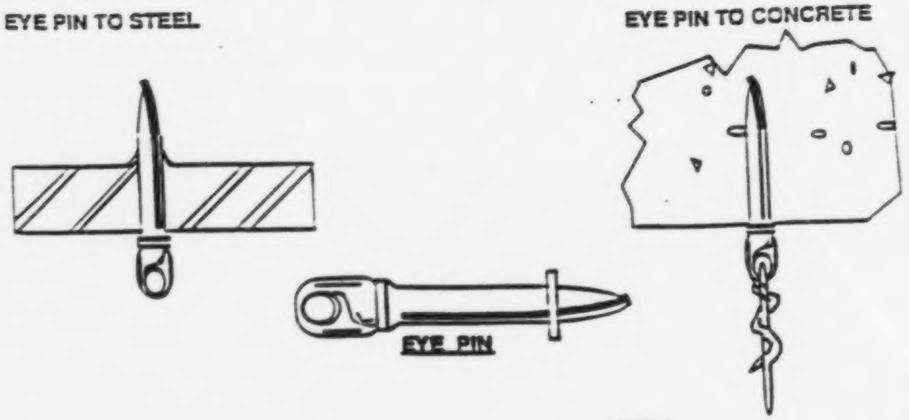

EYE PIN TO STEEL
EYE PIN TO CONCRETE
EYE PIN

Figure 5-5
Fastener Types

Drive pins are the most commonly used fastener. They have a ballistic shaped point at one end and a head at the other. They look similar to a regular nail. The whole portion of a threaded stud is driven into the material except for the threaded part. A washer and nut is put onto the threaded part to hold down the wood or steel. The threaded stud can be pulled out of the material if the nut is over tightened. Eye pins attach light fixtures, suspend ceilings and attach stone veneers to walls. An eyelet at the end allows for attachments to be made.

Fasteners should never be driven into very hard or brittle material. These materials include cast iron, glazed tile, hardened steel, glass block, natural rock, hollow tile, or some types of brick. The base material can be tested with a center punch to see if the fastening will work. (Figure 5-6) Drive the point of the fastener into the surface. If the fastener tip is blunted by the surface the fastening should not be made. If the fastening penetrates too deeply the fastening should not be made in this case, either.

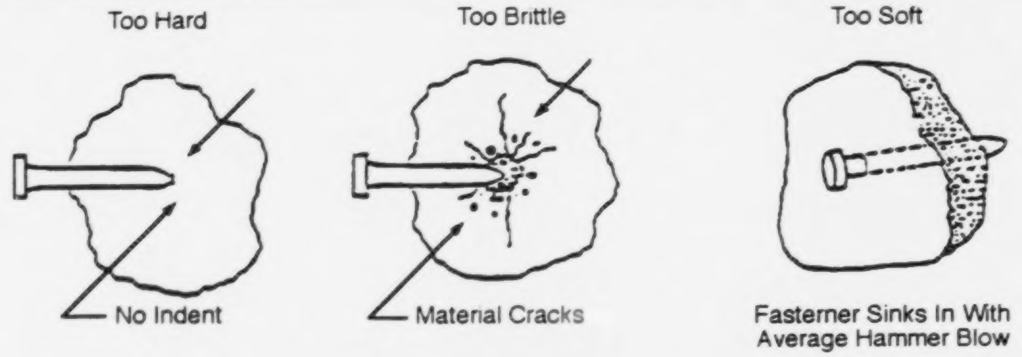


Figure 5-6

When you drive a fastener into masonry brick or block, the fastener should never be driven into the corner brick, vertical mortar joint or the surface of the block or brick. When making attachments to block or brick, drive the fastener into the horizontal masonry joint. Never drive a fastener into material that will crumble.

In order to make a test fastening with your Hilti, select the weakest cartridge, move the power dial on the side of the tool to the lowest setting. Load the tool with a fastener and attempt the first fastening. Gradually move the dial up and repeat the fastening tests until the fastener penetrates the surface at the correct depth. If the power dial is moved all the way to the highest setting, insert the next higher cartridge, move the power dial to the lowest setting and repeat the process.

Selecting the Piston and Fastener For The Hilti Dx450

The Hilti Product Catalogue recommends the yellow, red and purple powder load levels.

Table 5-2
Fastener Guide For 45/nk Piston

PISTON	FASTENER	USE
45/NK	NK drive pin	For fastening wood, sheet metal and metal strips to concrete. Also fastening wood to steel.
	ENK drive pin	For fastening sheet metal and metal strips to structural steel.
	W10 threaded stud	For fastening to concrete.
	EW10	For fastening threaded stud to structural steel

Selecting A Fastener For the Dx36m

The Hilti Product Catalogue recommends the red powder load cartridge for the DX36M.

Summary Questions

1. Can common nails be used in a Hilti powder actuated tool?

2. Name the most common type of fastener?

Table 5-3
FASTENERS FOR DX36M

FASTENER TYPE	USE
DN drive pin?	For fastening concrete. The shorter drive pin is for hard concrete and the longer drive pin is for softer concrete and masonry.
EDN drive pin	For fastening steel.
Threaded studs	For concrete and steel.
Eyelet pins	For fastening concrete.
M32 fastener	For fastener magazine.
M64 fastener	For fastener magazine.

3. When would you use a threaded stud to make a fastening?

4. What will happen if you over tighten a threaded stud?

5. What 2 surfaces should you avoid fastening?

6. Where do you drive the fastener on a masonry wall? Draw a simple picture to illustrate your point?

7. How would you check a surface to see if you could make a proper fastening?

8) What technique would be used to make a test fastening?

Hilti DX450 Features

There are six features on the Hilti DX 450 (Figure 5-7) that you should know:

1. Magazine powder loads (cartridges) come in plastic strips of 10 and advance automatically.
2. The power regulator can quickly adjust the power on the tool.
3. The coacting piston better safety and lower recoil.
4. The DX 450 drives a wide range of fasteners.
5. The DX 450 is simple, safe and quick to load.
6. A silencer helps to reduce noise and improve operator comfort.

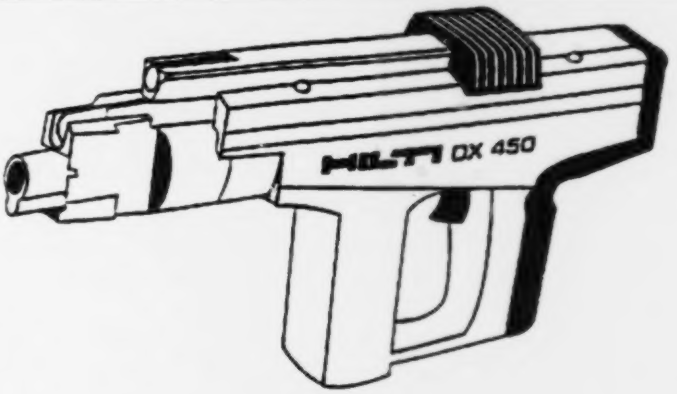


Figure 5-7
Hilti DX 450

Taking Apart the Hilti Dx450

In order to take the Hilti DX450 apart (Figure 5-8), follow these directions:

1. Lift the cocking lever slightly forward, and disconnect the catch, attached to the housing.
2. Unscrew the base plate from the housing.
3. Tilt the housing slightly forward and let the fastener guide slowly out of the base plate.
4. Slide the stop ring off of the fastener guide.
5. Pull the piston guide out of the tool.
6. Push the piston out of the piston guide with a rod that is supplied with the tool.

Operating the Hilti Dx 450

To operate the Hilti DX 450 safely you must follow this sequence:

1. Hold the tool with the base plate pointed upwards. Insert the fastener into the cocking lever, point first. The fastener will slide into the cocking lever and it will be held in place by a magnet.
2. Pivot the cocking lever 180 degrees until it comes in direct line with the tool.
3. Pull the loading grip back as far as it will go on the cocking lever. This action forces the fastener into the fastener guide. Slide the loading grip forward and return the cocking lever back into its original position.
4. The last step is to insert the powder load cartridge all the way into the tool grip.

1. Baseplate
2. Fastener Guide
3. Stop Ring
4. Housing
5. Piston Guide
6. Piston

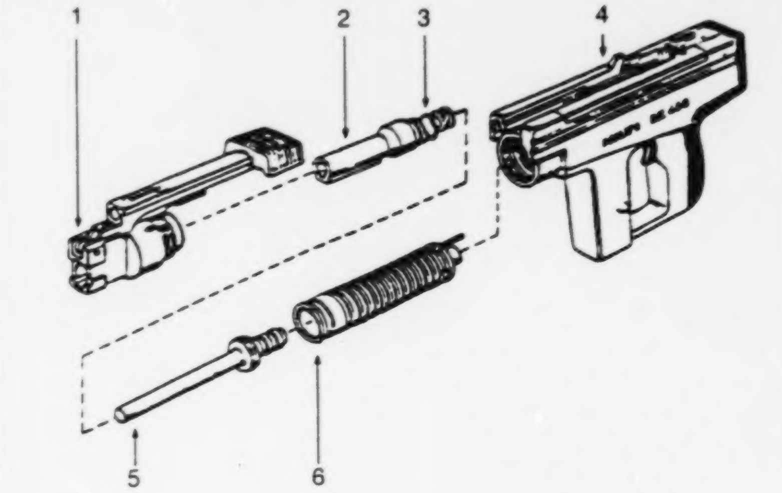


Figure 9-8
Parts For the Hilti DX 450

Features Of the Hilti Dx36m

The DX36M fastens drive pins and threaded studs. The magazine cartridges come in plastic strips of 10 and advance automatically. An optional fastener magazine assembly can hold 10 magazine fasteners for "production type" fastenings. The DX36M is a low velocity powder actuated tool which operates on the impact piston principle. The power regulator can quickly adjust the power on the tool. A silencer helps to reduce noise and improve operator comfort.

Taking Apart the Dx36m

In order to take apart the Hilti DX36M, follow these instructions:

1. Remove the fastener magazine by pushing it into the tool and turning the magazine 180 degrees, so that it is facing in the opposite direction.
2. Pull out the fastener magazine.
3. Turn the round rubber ring at the front of the tool 1/4 turn until the hinge stop clicks out of position.
4. Pull on the rubber ring and slide the barrel assembly out of the housing. (If the barrel assembly sticks, give it a quick tug)
5. Using the metal push rod provided in the tool kit, push the metal spring clip sideways, off of the assembly.
6. Separate the fastener guide and the piston guide.
7. Pull the piston out of the guide with your hand or push the piston out of the guide using the piston push rod.
8. Once you have inspected the parts and they are cleaned you can assemble the tool.

Hilti Dx36m Assembly

1. Align the long open slot in the barrel assembly with the hinge stop.
2. Push down the hinge stop, hold the rubber ring at the front of the tool, and turn the ring 1/4 turn until it clicks into place and the hinge stop is in position.
3. Insert the fastener magazine into the tool, opposite to the rubber hand grip. Push the fastener magazine into the housing and turn it 180 degrees. Hold the rubber ring and try to pull out the fastener magazine. If it does not pull completely out of the tool it has been inserted properly.

Operating the Dx36m

The Hilti DX36M must be operated in the following manner:

1. Pull out the barrel assembly all the way, using a quick snapping motion. Push the barrel assembly all the way inside the tool housing.
2. Insert the cartridge into the base of the grip until plastic strip is flush with the handle.
3. Ensure that the power regulator is at the proper setting.
4. Insert the clip of 10 fasteners into the fastener magazine.
5. Push the tool against the work surface and fire.
6. Cock the tool by pulling the barrel assembly all the way out of the tool housing and then pushing it all the way back in again. This will advance the powder load cartridge and the fastener.
7. Push against the work and fire again.
8. Repeat the cocking and firing sequence. You can fire 10 fasteners in a row. If you count the number you are firing as you go, you will know when the fasteners have been used up.

Attaching a Hilti Fastener To Concrete

In most fastening situations, the concrete should be at least 2-1/2 inches thick. Never drive the fastener closer than 2 inches from an unsupported edge. If a fastener failed to attach properly you would have to drive another fastener at least 3 inches or more away from the failed fastener.

Attaching a Hilti Fastener To Steel

In most fastening situations the steel must be a minimum of 5/16th of an inch thick. The fastener should be driven all the way through the steel, if possible. The fastener must be 1/2 an inch away from the edge of the steel. Fasteners must be driven at least 2 inches away from a weld in the steel.

Summary Questions

1. What is the minimum thickness of concrete when driving a fastener with a Hilti DX36M and a DX450 tool ?
2. Can you fasten into concrete 8 inches thick?

3. How far away can you fasten from an unsupported concrete edge with a Hilti DX36M and a DX450?

4. What is the minimum thickness of steel when driving a fastener with a Hilti DX36M and a DX450 tool ?

5. Could you fasten into steel 1 inch thick?

6. How far away can you fasten from the edge of steel with a Hilti DX36M and a DX450?

Safety Considerations

Never use a powder actuated tool in an explosive environment. Ventilation must be provided when you use a powder actuated tool in a confined space.

Inspect your powder actuated tool every day. Do not use a defective tool. Mark "repair" on it and send the tool to the manufacturer. Never make any make-shift repairs to a defective tool. Servicing the tool on a regular basis will help prevent costly repairs.

Never use attachments and accessories unless they are recommended by the manufacturer. Use the proper spall attachment, stabilizer, guard, or accessory that is supplied by the manufacturer, for every application.

Never leave a loaded tool unattended. Never point a powder actuated tool (whether it is loaded or not) at any person. The muzzle of the tool should never be pushed into the palm of the hand.

Hold the tool perpendicular to the work surface while fastening any material. The tool may be used differently only if the manufacturer allows it.

If a Hilti powder actuated tool is misfired, Hilti recommends that you hold the tool against the work for at least 15 seconds, and refire the tool. If the powder load still misfires, wait 15 seconds while the tool is held in place and then eject the powder load and dispose of it in water.

Servicing and Cleaning

Hilti recommends that you service and clean their powder actuated tools daily because the tool will operate more efficiently and create less work disruptions. The brushes found inside each Hilti tool kit should be used for removing carbon build up on the tool. After each part is brushed, spray the surfaces with Hilti spray lubricant. The following parts should be cleaned and lubricated:

- Inside the housing.
- Inside and around the base plate.
- Inside and outside the fastener guide.
- The piston.
- Inside and outside the piston guide.

Wipe the surfaces of any excess spray so that carbon does not build up on these surfaces.

If the barrel assembly on the DX36M stiffens during operation, spray it with lubricant, and pull it in and out several times. If the trigger on either tool stiffens, pull away the rubber grip and lubricate the slides underneath the rubber.

Maintenance and Storage

A powder actuated tool must be serviced and inspected for worn and damaged parts at regular intervals. The inspection and servicing period will be determined by the manufacturer. If you find any tool that is not working properly you must take it out of service and put a "repair" tag on it. Any repairs should be made by a qualified person, according to the manufacturers instructions. If you discover that there are any worn or damaged parts you must replace those parts that are supplied by the manufacturer. These parts can be replaced only if you are qualified to replace them.

Each tool must be stored in a box that is provided by the manufacturer. You should find a copy of the manufacturers instruction manual, inside the box, as well as all tools and accessories needed for field servicing. All powder loads of different levels and types must be kept separate from each other. No powder actuated tool must ever be stored while it is loaded.

Summary Questions

1. Can you use a powder actuated tool in an explosive environment?

2. What do you do if the powder actuated tool is defective and it needs repair?

3. Can you leave a powder actuated tool unattended?

4. Can you point a unloaded powder actuated tool at a person?

5. What is the proper way to hold a powder actuated tool against the work surface?

6. What should you do, according to Hilti, if one of their powder actuated tools misfires?

7. Can you put different powder loads in the same container or box?

8. Can you store a loaded powder actuated tool in a locked storage area?

9. How often should you clean and service a Hilti DX450?

10. What parts of the Hilti DX450 should be cleaned?

11. What should you do after you have brushed away the carbon build up and sprayed the parts on a Hilti DX450?

12. What can you do if the trigger on the Hilti begins to stick?

13. What do you do if the barrel assembly on the DX36M begins to stiffen during a fastening operation?

Summary

Always carry your Hilti certificate with you on the job. An unexpected opportunity might arise at any time. If you do get the chance to operate a Hilti DX36M or a DX450, take the chance and make the best of it. This section has provided you with the skills, knowledge and confidence, to operate these powder actuated tools with confidence and care.

REVIEW QUIZ

GENERAL CONSTRUCTION - SECTION 5

1. List each of the strokes in 4 cycle and 2 cycle gasoline engines in order of occurrence?

____

____

____

____

2. How many ounces of 2 cycle oil would you add to 5 gallons of gasoline to obtain a 32:1 ratio?

   a. 8
   b. 12
   c. 16
   d. 20
   e. 24

3. What weight of oil should be used in the crankcase of a small engine?

   a. 5W 30
   b. 30
   c. 10W 30
   d. 20W 50

4. When troubleshooting an engine that will not start, list 4 items that you should check?

____

____

____

____

5. Name the 2 common types of water pumps used on construction sites?

____

____

6. What procedures should be followed at the end of the day when you are using a pump in below freezing weather?

   a. remove drain plug

   b. flush out any remaining solids

   c. run the pump for about 15 seconds with the drain plug out to assure all water is removed

   d. all of the above

7. List 3 ways you can prevent kickback from occurring when using a chain saw?

____

____

____

8. List 4 safety features on a chain saw?

____

____

____

____

9. The blade on an all purpose saw should not match or exceed the maximum operating speed of the saw? True or false?

   a. True

   b. False

10. What throttle speed should you use when cutting with a chain saw or all purpose saw?

    a. 1/8 speed

    b. 1/4 speed

    c. 1/2 speed

    d. 3/4 speed

    e. full throttle

11. How often should the air filter of an all purpose saw be checked when cutting in dusty conditions?

    a. once a day

    b. twice a day

    c. every hour

    d. every half hour

    e. when the filter is clogged

12. What is the function of a GFI?

    a. increases the voltage to the electric tool

    b. detects the amount of current going through the electric cord

    c. detects current leakage and quickly shuts off the power supply

    d. leads mercenary missions to the deep jungles of South America

13. Every electric tool must have a three prong plug. True or false?

    a. True

    b. False

14. Name 3 things that should be considered before selecting a cord for an electric tool?

    ____

    ____

    ____

15. Complete the following statement. Many newer compressors will not start if the compressor is more than ____________ off level.

    a. 3 - 6 degrees

    b. 9 - 11 degrees

    c. 11 - 13 degrees

    d. 17 - 20 degrees

16. Why is it important to check the pop off valve on a compressor?

    ____

    ____

17. What is the pre-set air pressure in an air compressor?

    a. 60 - 80

    b. 80 - 100

    c. 100 - 120

    d. 120 - 140

18. What should you do with the 90 pound pavement breaker when it is not pushing against the work?

    a. turn the trigger on

    b. turn the trigger off

    c. operate the breaker at 1/2 throttle

    d. operate the breaker at 3/4 throttle

19. What size of bits fit inside the 60 and 90 pound pavement breaker?

    a. 1-1/8" & 1-1/4"

    b. 1" & 1-1/2"

    c. 1-1/8" & 1-1/2

    d. 1-1/16 & 1-1/4

20. Name the 6 lowest powder load strengths by number and color?

____

____

____

____

____

____

21. Hilti powder actuated tool fasteners are driven into which 2 kinds of material?

____

____

22. How far away from a concrete edge should a Hilti fastening be made?

a. 1"

b. 2"

c. 3"

d. 4"

23. How far away from a steel edge should a Hili fastening be made?

a. 1/4"

b. 1/2"

c. 3/4"

d. 7/8"

SECTION VI
COMPACTION

Trainee Objectives

Trainees should learn:

1. Use of P.P.E. necessary to operate compaction equipment.
2. Why compaction is necessary at construction sites and where compaction is used.
3. To identify soil types, moisture needed for good compaction, and the type of compactor used for each soil type.
4. How to use each type of compactor and compaction techniques.

SECTION VI
INSTRUCTOR OUTLINE

1. Show video TIPS AV8 "Soils and Compaction"
2. Discuss use of P.P.E. for compaction equipment, such as toe caps or steel toe shoes, eye and ear protection.
3. Discuss different compaction equipment to include: rammers, vibrating compactors, and pneumatic powered compactors (pogo stick).
4. Demonstrate the effects of moisture on soils. Use dry soil and try compaction, then add water and show effects on compaction. Also demonstrate each piece of compaction equipment and techniques used for proper compaction.

Hands-On For Compaction

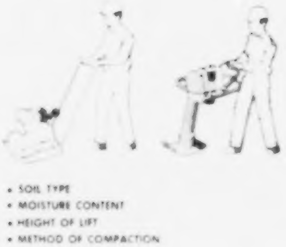
1. Have trainees operate compaction equipment. Add 4" to 6" of fill to an area and compact. Use different types of soil if possible. Dig a trench and backfill.
2. Practice with each type of compaction equipment to see effects on different soils. Add moisture when necessary.

LABORERS-AGC TRAINING TIPS

No. 8

TRAINEE INFORMATION PROFILE SERIES

SOILS AND COMPACTION



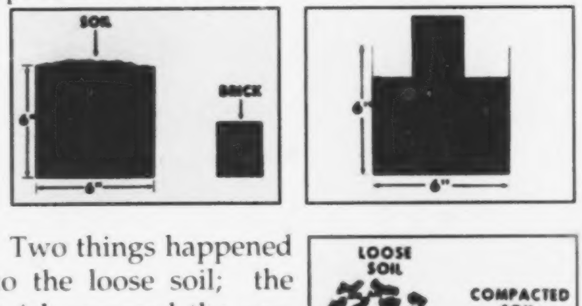
Compaction is one of the most important jobs performed on a construction site. Unfortunately proper compaction is sometimes taken for granted. When done correctly a compacted surface provides a solid base for buildings, highways and pipelines. When rushed or improper methods are used it's like a time bomb waiting to go off.

This manual is designed as a supplement to the video "SOILS AND COMPACTION" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

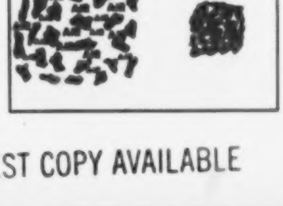
When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

A SMALL DEMONSTRATION

In this demonstration a brick was used to tamp down loose soil in a box. Once the dirt was completely tamped down, it occupied less space in the box.



Two things happened to the loose soil; the brick rammed the particles of soil closer together and air trapped between the particles was forced out.



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This process of tamping with a brick to make the dirt occupy less space and become firm and hard is called, COMPACTION.

Compaction is necessary to get a solid base for buildings and structures. Without compaction, foundations would settle and walls would crack. Highways would crack and pipe lines would break.

THE PROCESS OF COMPACTION

Four things influence the process of soil compaction:

- soil type
- moisture content or the amount of water in the soil
- the height of the lift, or the thickness of layers of loose soil to be compacted
- the method of compaction

Lets examine each of these.

Soil conditions vary throughout the country. Certain regions are primarily either sand or clay. In most areas the soil is usually mixtures of gravel, sand, clay, silt and loam. Silt is very fine and smooth ground rock. A good example of silt is the material deposited at the drainage end of pipes and culverts. Loam is a mixture of sand, silt and clay. An example of loamy soil is river bottom topsoil.

In the process of compaction we are concerned with three kinds of soil:

- Cohesive
- Partly-Cohesive
- Non-Cohesive, or Granular.

Cohesive soils are loam and clay, soils that bind or stick together.

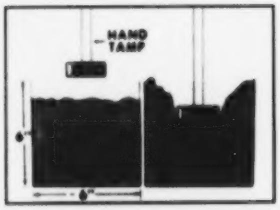
Partly-Cohesive soils include sand-clay mixes, silt and mixtures of sand and silt.

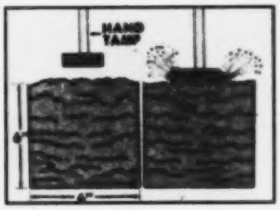
No-Cohesive or Granular soils are sand, gravel and mixtures of sand and gravel, soils which do not stick together.

MOISTURE IS A MUST

Soil moisture is important in compaction. If there is too much water in the soil, it will "pump" and not compact. When you push wet soil down in one place, it will "pump" up in another.

If the soil is too dry, it will "fluff" up and you still won't get compaction.





The right amount of water in the soil acts as a lubricant (or oil) on the particles. Compacting properly watered soil makes the particles slide very close together forcing most of the air out.

When you add water to soil, you can tell if the moisture content is about right by squeezing a handful of the dirt. If it takes and holds the shape of your grip, it has the right amount of water.

TYPES OF COMPACTORS

The machines used by laborers compact the soil in three basic ways:

- By Impact - a ramming action which forces out the air and drives the soil particles together.
- By Vibration - which shakes the particles closer together and forces out the air.
- By a Combination of these two methods, Impact and Vibration.

Vibratory machines work best with granular or non-cohesive soils such as sand, gravel and mixtures of these.

Partly cohesive soils such as sand-and-clay mixes, silt and sand-silt mixes are best compacted by those machines that use the combined impact-vibration method.

Machines with a pounding action should be used when compacting cohesive soils such as clay and loam, or mixtures that are mostly clay.

BACKFILLING

The height of the lift, or backfill layer of loose soil to be compacted, also has to be considered. Your labor foreman will tell you wha size the lift should be. They usually range from 6 - 12 inches.

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"Fill" has to be clean, free of roots, cans and other debris, that could rot or rust and leave holes in the compacted soil.

The lift has to be leveled off each time fill is placed, before you start compacting. It's much harder to run a machine over a surface that is not level.

Before compacting around pipe remove any large rocks that are against it. Avoid hitting the pipe with the compactor and make sure there is enough fill on top of the pipe

Remember - the factors that influence soil compaction vary: the type of soil, the moisture content, height of lift and method of Compaction. To compact effectively, you must consider all of these factors on each job.

KEY POINTS TO REMEMBER

- KNOW THE SOIL YOU ARE WORKING WITH.
- PROPERLY WATER THE SOIL TO BE COMPACTED.
- USE THE RIGHT COMPACTOR FOR THE JOB.
- BACKFILL ONLY IN RECOMMENDED LIFTS.
- USE CAUTION WHEN COMPACTING AROUND PIPE.

General Occupational Safety and Health Regulations
Soils and Compaction

ITEM	REFERENCE
Personal Protective Equipment **(Head, Foot, Hand, Hearing, Eye/Face, Respiratory)**	**29CFR 1926.28**
Hazard Communication	**29CFR 1926.59**
General Safety and Health Requirements	**29CFR 1926.20**
Safety Training and Education	**29CFR 1926.21**

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts.

Laborers-AGC Education and Training Fund wishes to thank the following for their help in revising this manual:

Leonard Butts, Laborers Training & Retraining Trust Fund for Northern California.
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Mike Warren, Northwest Laborers-Employers Training Trust Fund.

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LABORERS-AGC
EDUCATION AND TRAINING FUND
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SECTION VII
HAND SIGNALS

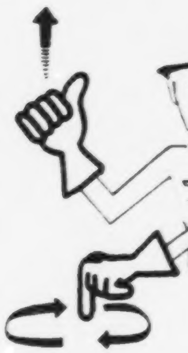
Trainee Objectives

Trainees should learn:

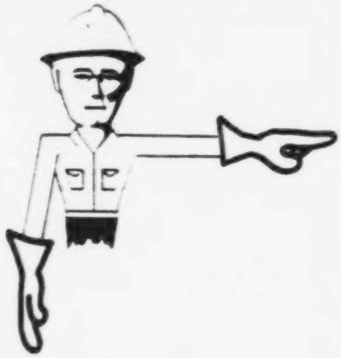
1. Hand signals for various types of equipment/
2. How to signal the operator and where to stand when signaling.
3. Importance of correct signaling for safety and efficiency.

SECTION VII
INSTRUCTOR OUTLINE

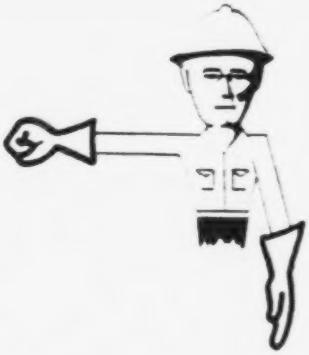
1. Review hand signal charts in trainee manual. Demonstrate signals and note differences for various equipment.
2. Use equipment of simulate equipment and have trainees give signals to perform different operations.
3. Practice hand signals for the following equipment:
    a. crane
    b. backhoe
    c. forklift
    d. concrete pump
    e. trucks
    f. helicopter



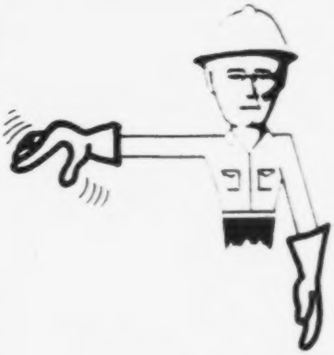
RAISE THE BOOM AND LOWER THE LOAD



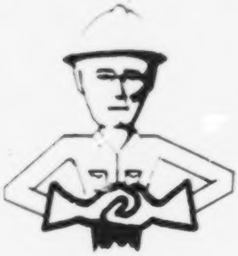
SWING IN DIRECTION FINGER POINTS



CLOSE BUCKET

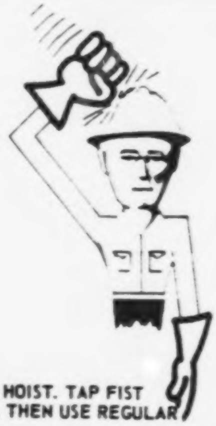


OPEN BUCKET



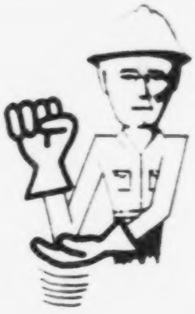
DOG EVERYTHING

(LOCK ALL BRAKES, DO NOT MOVE UNTIL FURTHER INSTRUCTIONS ARE GIVEN.)



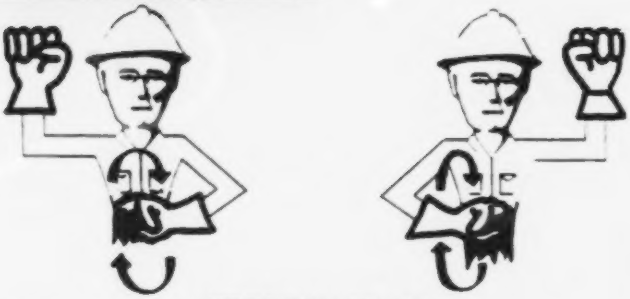
USE MAIN HOIST. TAP FIST ON HEAD, THEN USE REGULAR SIGNALS.

[illegible] CRANES



USE WHIP LINE.

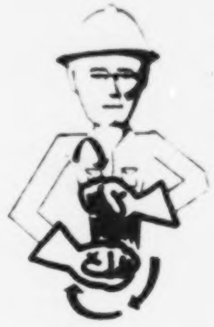
(AUXILIARY HOIST) TAP ELBOW WITH ONE HAND, THEN USE REGULAR SIGNALS.



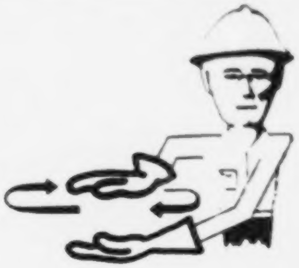
MAKE RIGHT OR LEFT TURN AS INDICATED BY CLENCHED FIST.

LEFT

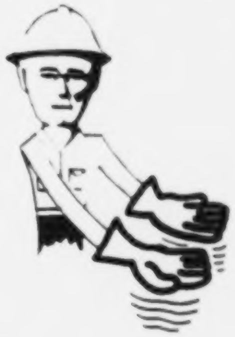
RIGHT



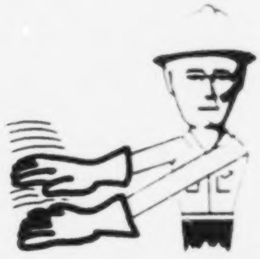
TRAVEL BOTH TRACKS



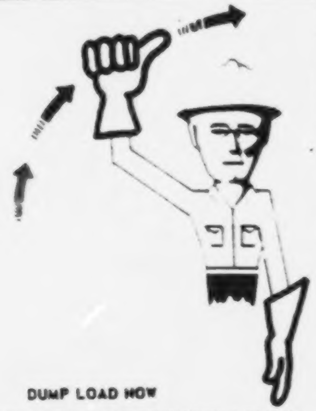
WHEN CUT FILL OR HAUL ROAD IS TO BE DRAGGED OR BLADED. POINT TO THE AREA, THEN RUB PALMS OF HANDS TOGETHER INDICATING A SMOOTHING MOTION. APPLIES TO SCRAPERS, MOTOR GRADERS AND BULLDOZERS.



RAISE A LITTLE

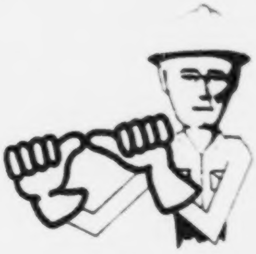


LOWER A LITTLE

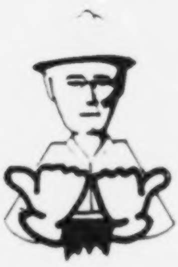


DUMP LOAD NOW

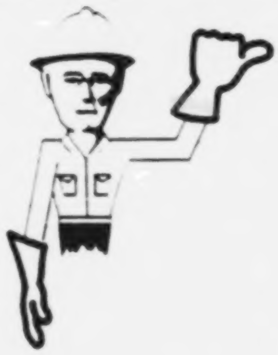
(START DUMPING AND SPREADING LOAD TO PROPER DEPTH IF GIVEN.)



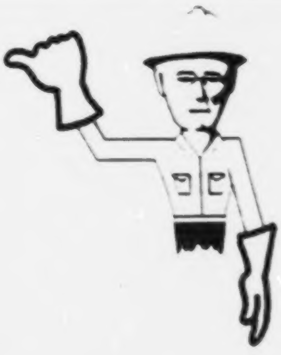
REHAUL OR RETRACT



CROWD OR EXTEND



TURN RIGHT (TO THE OPERATOR'S RIGHT.)



TURN LEFT (TO THE OPERATOR'S LEFT.)

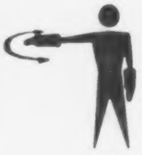
CISCO

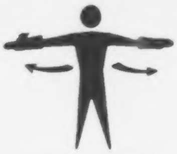
Construction Industry
Safety Committee of Ohio

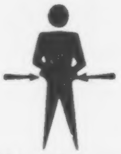
CRANE SIGNALS

THE INDUSTRIAL COMMISSION OF OHIO
DIVISION OF SAFETY AND HYGIENE

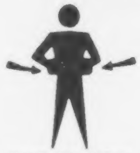
STOP SIGNALS

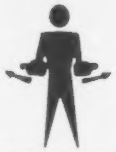

STOP


EMERGENCY STOP

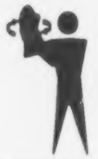

DOG EVERYTHING

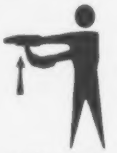
TELESCOPING BOOMS

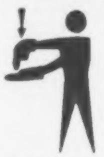

SHORTEN BOOM

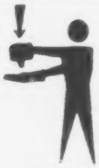

EXTEND BOOM

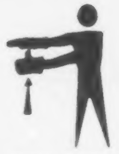
SLOW SIGNALS


MAKE MOVEMENTS SLOWLY

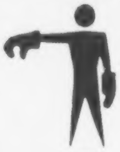

RAISE LOAD SLIGHTLY

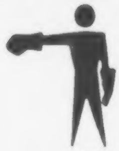

LOWER LOAD SLOWLY


LOWER BOOM LIGHTLY

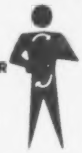

RAISE BOOM SLOWLY

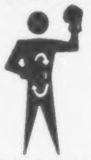
CLAM BUCKET SIGNALS


OPEN

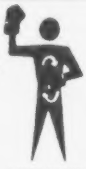

CLOSE

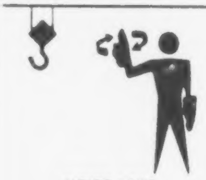
CRAWLER or TRACK SIGNALS

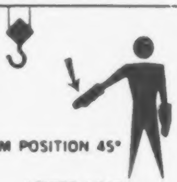

TRAVEL BOTH CRAWLER BELTS IN DIRECTION INDICATED BY REVOLVING FISTS

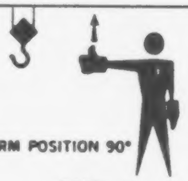

RIGHT TURN

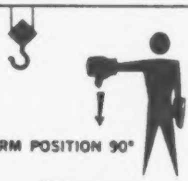
LOCK THE CRAWLER BELT ON THE SIDE INDICATED BY RAISED FIST . . . TRAVEL OPPOSITE CRAWLER BELT IN DIRECTION INDICATED BY REVOLVING FIST

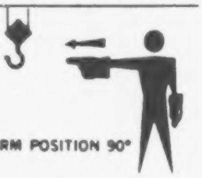

LEFT TURN

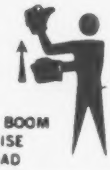

HOIST LOAD

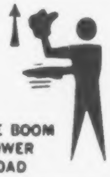

ARM POSITION 45°
LOWER LOAD


ARM POSITION 90°
BOOM UP

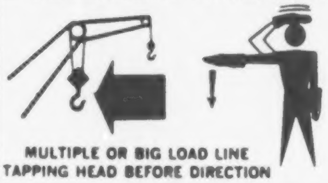

ARM POSITION 90°
BOOM DOWN

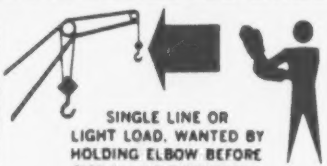

ARM POSITION 90°
SWING


RAISE THE BOOM AND RAISE THE LOAD


RAISE THE BOOM AND LOWER THE LOAD

SELECTING SINGLE or MULTIPLE REEVED LINES


MULTIPLE OR BIG LOAD LINE TAPPING HEAD BEFORE DIRECTION


SINGLE LINE OR LIGHT LOAD, WANTED BY HOLDING ELBOW BEFORE SIGNALLING DIRECTIONS

INSTRUCTIONS TO SIGNALMEN

1. Only one person to be signalman
2. Make sure the Operator can see you and acknowledges the signal given
3. Signalman must watch the load — the Operator is watching you
4. Don't swing the load over other workers; warn them to keep out of the way

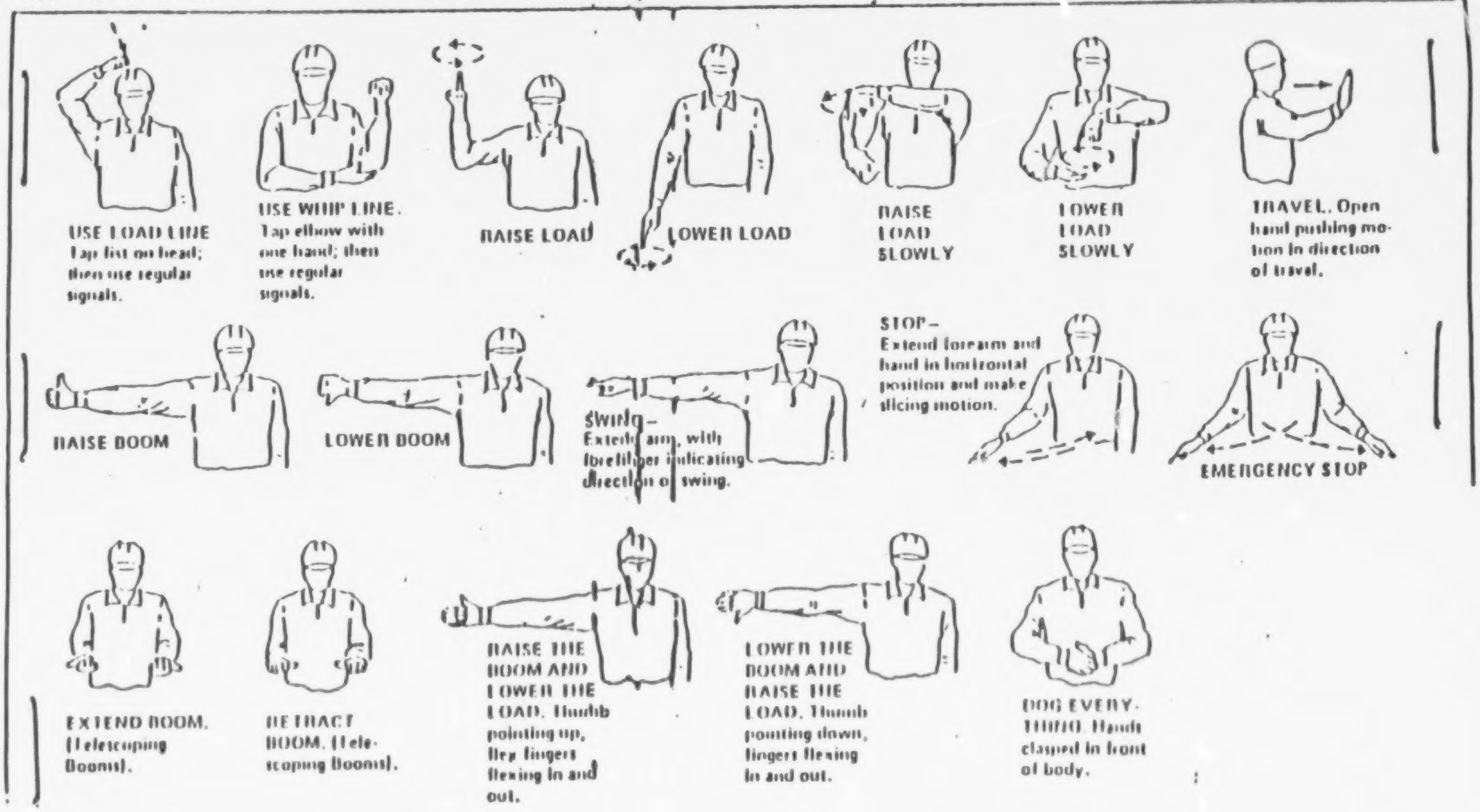
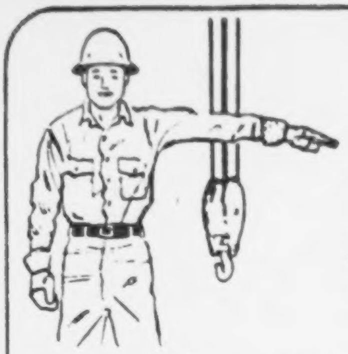
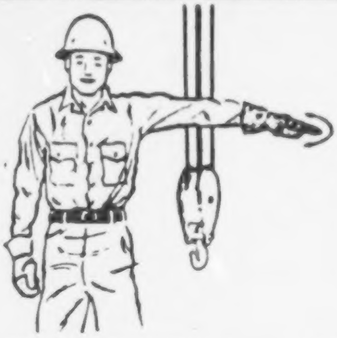

USE LOAD LINE
Tap fist on head; then use regular signals.
USE WHIP LINE.
Tap elbow with one hand; then use regular signals.
RAISE LOAD
LOWER LOAD
RAISE LOAD SLOWLY
LOWER LOAD SLOWLY
TRAVEL. Open hand pushing motion in direction of travel.
RAISE BOOM
LOWER BOOM
SWING–
Extend arm, with forefinger indicating direction of swing.
STOP–
Extend forearm and hand in horizontal position and make slicing motion.
EMERGENCY STOP
EXTEND BOOM. (Telescoping Booms).
RETRACT BOOM. (Telescoping Booms).
RAISE THE BOOM AND LOWER THE LOAD. Thumb pointing up, flex fingers flexing in and out.
LOWER THE BOOM AND RAISE THE LOAD. Thumb pointing down, fingers flexing in and out.
DOG EVERYTHING. Hands clasped in front of body.

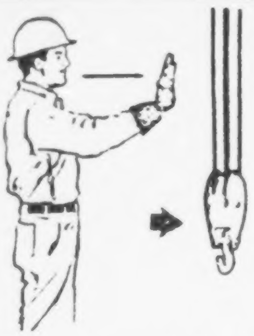
Fig. 4-16. Hoisting hand signals.



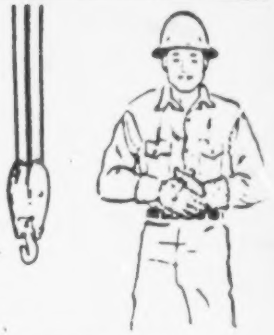
STOP. Arm extended, palm down, hold position rigidly.



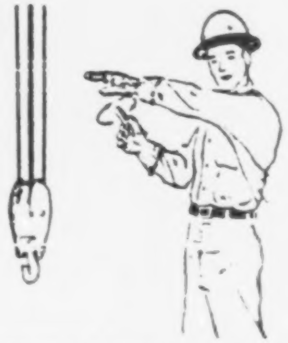
EMERGENCY STOP. Arm extended, palm down, move hand rapidly right and left.



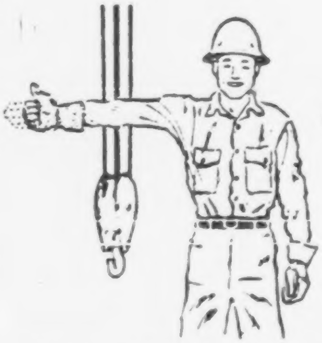
TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.



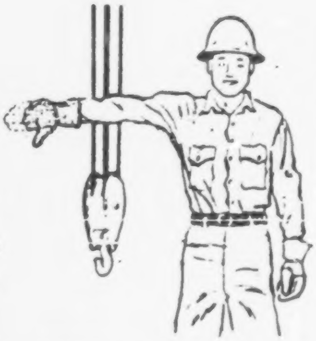
DOG EVERYTHING. Cla hands in front of body.



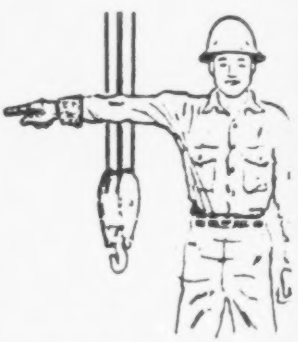
MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)



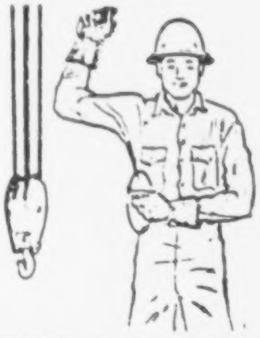
RAISE BOOM/LOWER LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.



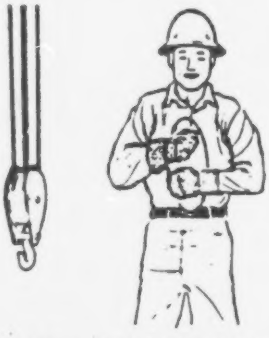
LOWER BOOM/RAISE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.



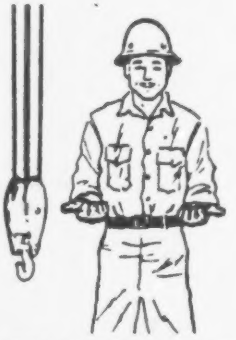
SWING. Arm extended, point wi finger in direction of swing of boo



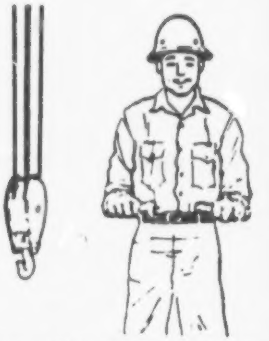
TRAVEL. *(One Track.)* Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of the other fist, rotated vertically in front of body. *(For crawler cranes only.)*



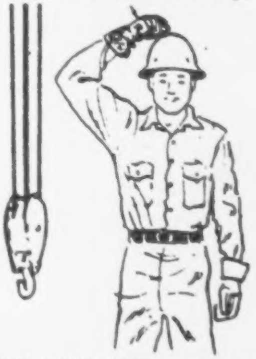
TRAVEL. *(Both Tracks.)* Use both fists, in front of body, making a circular motion, about each other, indicating direction of travel; forward or backward. *(For crawler cranes only.)*



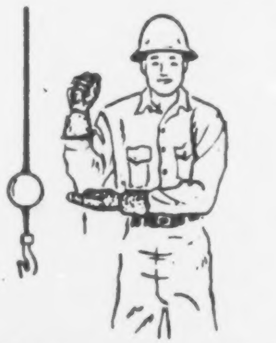
EXTEND BOOM. *(Telescoping Boom.)* Both fists in front of body with thumbs pointing outward.



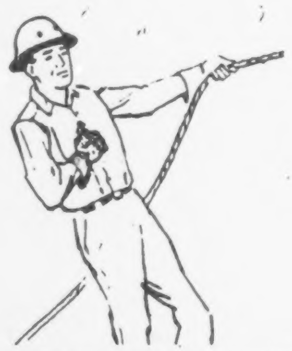
RETRACT BOOM. *(Telescopi Booms.)* Both fists in front of bo with thumbs pointing toward e other.



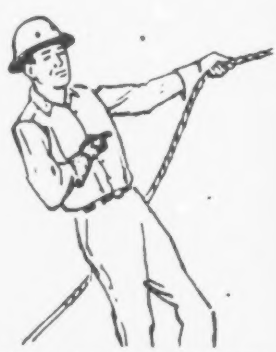
USE MAIN HOIST. Tap fist on head; then use regular signals.



USE WHIP LINE. *(Auxiliary Hoist.)* Tap elbow with one hand; then use regular signals.



EXTEND BOOM. *(Telescoping Boom).* One fist in front of chest with thumb tapping chest.



RETRACT BOOM. *(Telescopi Boom.)* One fist in front of ches thumb pointing outward and heel c fist tapping chest.

SECTION VIII
KNOTS AND RIGGING

Trainee Objectives

The trainees should learn:

1. To become aware of safety hazards associated with the use of ropes, synthetic web (nylon) slings, and cables for material handling purposes.
2. The knots and hitches commonly used in construction.
3. To become aware of the use of cables and their proper application.
4. Rigging techniques with the use of chokers and slings for different types of construction loads.
5. To demonstrate competency making knots and hitches, and using them to rig different loads.
6. To demonstrate competency in the application of cable clamps for making an eye at the end of a cable and making multiple leg slings.
7. To demonstrate competency rigging loads using manila ropes, synthetic web (nylon) slings, and cables.

SECTION VIII
INSTRUCTOR OUTLINE

1. Discuss types of manila rope slings commonly used. Discuss safe working loads and rope efficiency when using different applications and rigging practices. Discuss the above practices for wire rope (cables) and synthetic web (nylon) slings.
2. Discuss inspection of all types of rigging and rigging hardware.
3. Practice tying knots and hitches and use on various applications.
4. Discuss and practice the proper use of cable clamps to make slings with hooks and rings (single and multiple leg slings), and connecting two cables.
5. Rig loads using cable slings and chokers. Teach rigging techniques for various types of construction loads; pipe, rebar, beams, lumber, etc.
6. Discuss and practice the use of synthetic web (nylon) slings.

SECTION VIII
RIGGING

Even though there is much material in this upcoming section, it only covers general rigging and hoisting techniques.

Make every lift a safe lift, without endangering yourself or others. This section will raise your awareness of the potential dangers involved whenever you make a lift.

Procedures and Precautions

Before making any lifts you must know the lifting capacity of the equipment and the weight of the load. When the center of gravity is below the hook the load is much more stable. Check slings and hardware on each lift.

Destroy any faulty equipment that is unsafe, do not set it aside or throw it in the garbage. Other workers may not be aware that the rigging equipment is faulty. They could use the faulty equipment unknowingly, which could cause a dangerous situation.

Communicating with the operator is crucial in every lifting situation. Dust, darkness, snow, rain or fog can hinder this process. Take extra care in these conditions. Relay the hand signals or use a two way radio if the need arises.

Any lift should be made as smoothly as possible to avoid shock loading or sudden impact. Lift vertical to prevent unnecessary stress placed on the lifting line.

Extra safety precautions must be followed while working around power transmission lines.

More Safe Lifting Tips

- Protect slings from sharp corners.
- No bending should exist near splices or fittings.
- Never wrap a rope around a hook.
- The shackle pin should never come into contact with the running line.
- Use thimbles in the eye of the sling.
- If you have to put more than 2 slings over a hook, use a shackle to keep the load centered.
- Control loads with tag lines.
- Attach loose end of a sling to the lifting ring or shackle to prevent snagging.

Safe Signaling

A signal person can make their job safer and easier by following these suggestions:

- Stay in view of the operator.
- Stay in constant view of the load as it travels through the air.
- Stay in communication with the operator.
- Use hand signals only when they are seen clearly by the operator.
- Wear highly visible gloves.
- Wear a signalers vest.
- Keep other workers away from the lifting path.
- Never make a lift over anybody.
- Know the proper hand signals and confirm these signals with the operator.

Rigging Hardware

Wire Rope

Wire rope is the most common rigging and lifting material in use in the construction industry. It is commonly found spooled onto cranes and winches on all types of equipment. In addition to its use on equipment it is the most common material used to shape chokers and rigging slings for picking different types of construction materials and supplies.

There are many types and sizes of wire rope. All consisting of many individual wires laid into a number of strands which are laid around a central core (Figure 8-1). The size and number of strands determine the strength of a given wire rope.

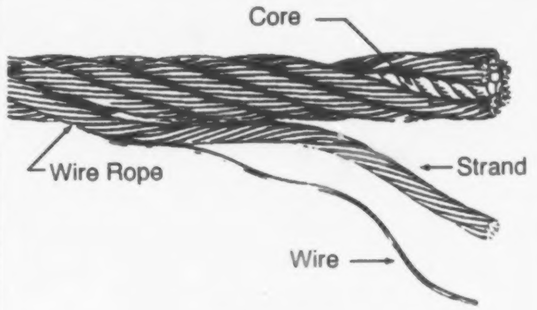

Core
Wire Rope
Strand
Wire

Figure 8-1
Composition of Wire Rope

Even though wire rope is extremely strong and wear resistant it is still subject to fatique from mis-use or overuse. Care must be taken to insure that the wire rope is in good working order and that defects affecting the strength are not present. Signs of fatique or mis-use range from wire cracks to flattening or kinking. Other indicators of a fatiqued wire rope are stretching and wear on the outer surface of the strands.

Thimbles, Clips, and Eyes

The proper use of thimbles and clips will greatly increase the life of wire rope. Mis-use can not only cause shortened life span but can create extremely dangerous lifting situations that are to be avoided at all costs. Figure 8-2 through 8-8 show the correct assembly and use procedures for various wire rope and fastener combinations.

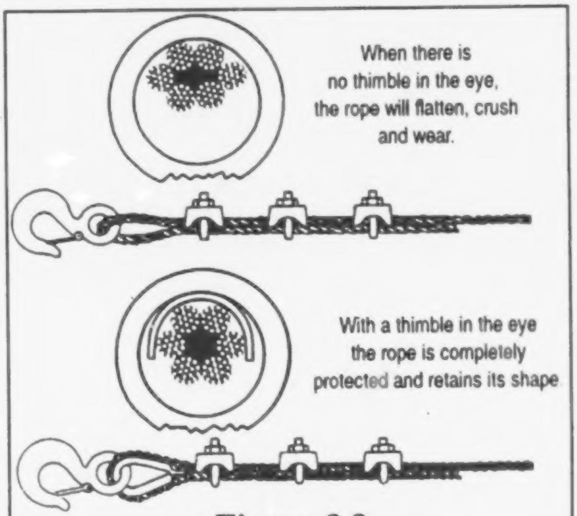

When there is no thimble in the eye, the rope will flatten, crush and wear.
With a thimble in the eye the rope is completely protected and retains its shape

Figure 8-2
Why a Thimble Should be Used in All Eyes

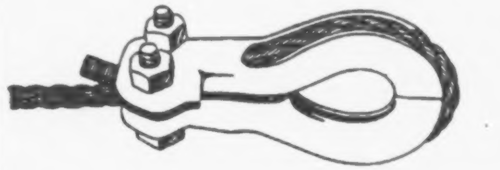


Figure 8-3
Clamp and Thimble Connection

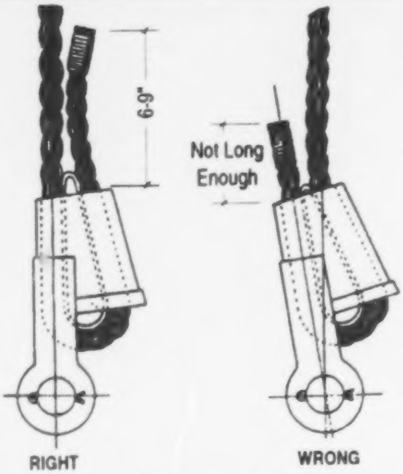


Figure 8-4
Correct Installation of a Wedge and Socket

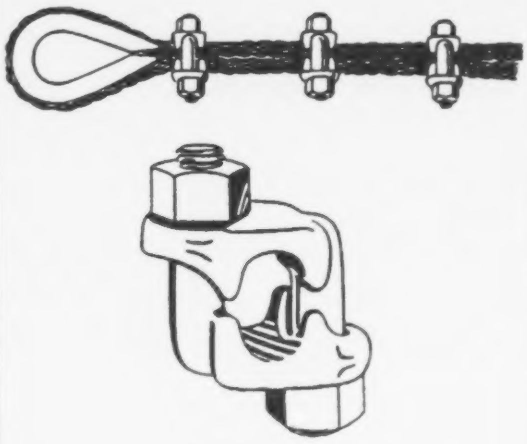
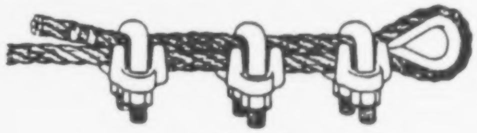
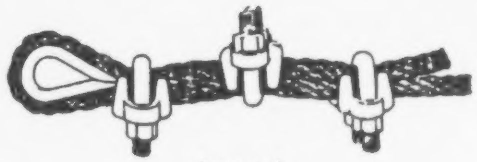


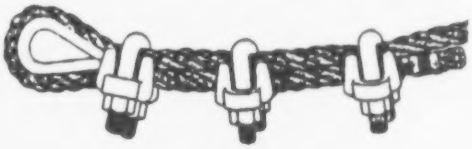
Figure 8-6
Double Saddle Clips (Fist Grip Clips)



Correct
U-Bolt of all clips
on dead end of rope



Incorrect
Do not stagger clips



Incorrect
U-Bolt on all clips
on live end of rope

Figure 8-5
Right and Wrong Ways of Using Cable Clips

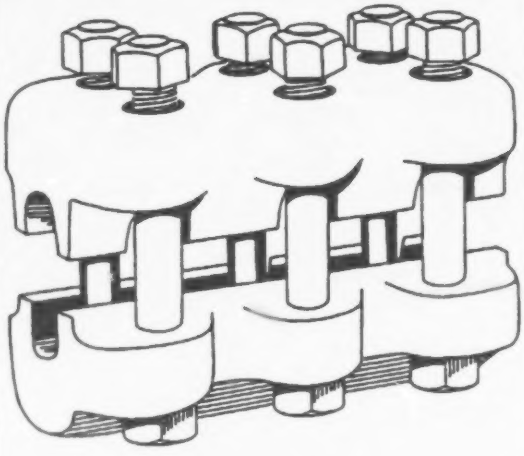
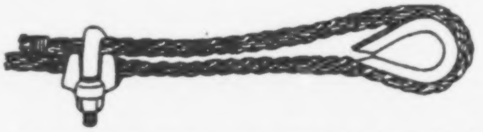


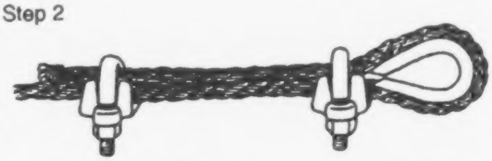
Figure 8-7
Double Base Clamp

Step 1



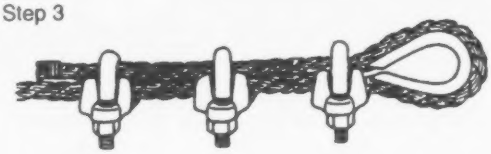
APPLY FIRST CLIP - one base width from dead end of wire rope - U-Bolt over dead end - live end rests in clip saddle. Tighten nuts evenly to recommended torque.

Step 2



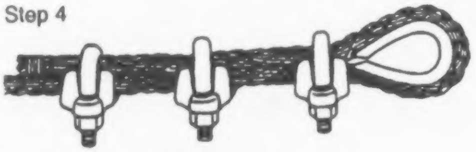
APPLY SECOND CLIP - nearest loop as possible U-Bolt oveR dead end - turn on nuts furm but DO NOT TIGHTEN.

Step 3



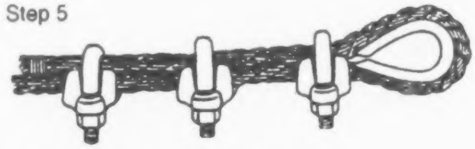
ALL OTHER CLIPS - Space equally between first two.

Step 4



Apply tension and tighten all nuts to recommended torque.

Step 5



Re-check nut torque after rope has been in operation.

Figure 8-6
Proper Method of Installing Cable Clips

Hooks and Shackles

Hooks are built in a variety of styles, some designed for specific types of lifting. Figures 8-7 to 8-10 depict some of the more common hook styles and their uses.

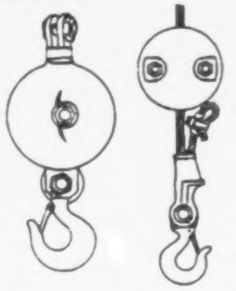


Figure 8-7
Standard "Headache" Ball for a Crane.

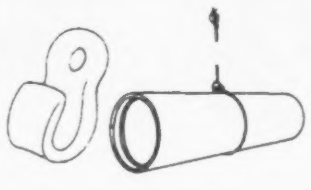


Figure 8-8
Standard Choker Hook

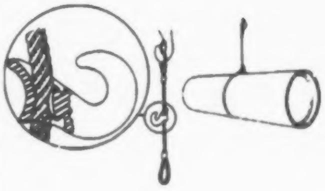


Figure 8-9
Adjustable Sliding Choker Hook

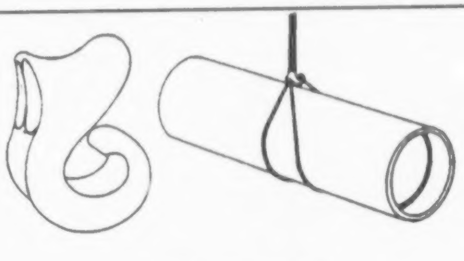


Figure 8-10
Dual Sliding Choker Hook

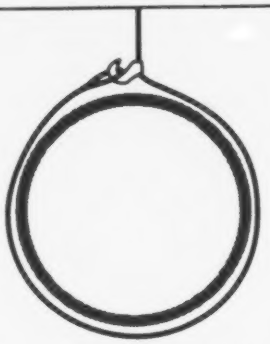
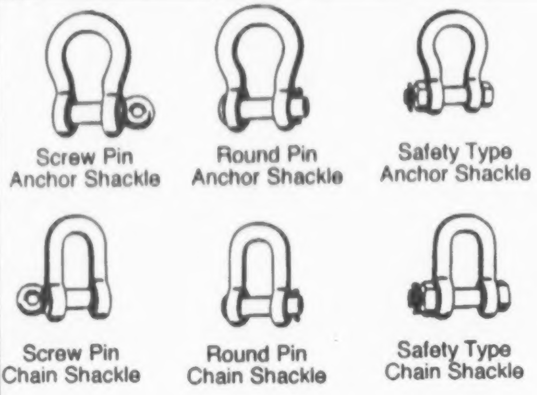


Figure 8-11
Always rig a sliding choker hook
in the "UP" position

When using a sliding choker hook, always rig the hook in the "UP" position. This will prevent the hook from disengaging from the eye if the load is reduced on the choker. (Figure 8-11)

Shackles also are manufactured in a variety of shapes and sizes. Several common varieties are shown in Figure 8-12 below.

Shackle bolts must always be checked before each lift. These bolts loosen from normal lifting conditions and at other times they may not have been fully tightened by the person at the other end of the lift.



Screw Pin Anchor Shackle
Round Pin Anchor Shackle
Safety Type Anchor Shackle
Screw Pin Chain Shackle
Round Pin Chain Shackle
Safety Type Chain Shackle

Figure 8-12
Common Shackle Types

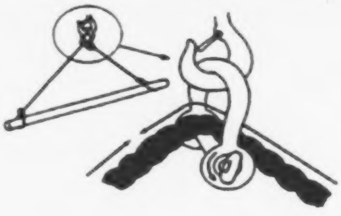
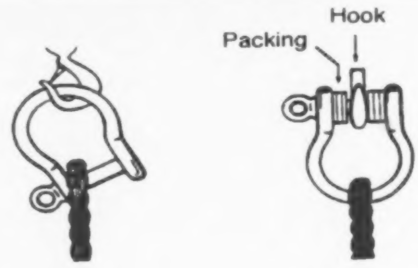


Figure 8-13
Never rig a load that may
roll and unscrew the shackle pin.



Incorrect
Never allow shackle
to be pulled at an
angle, the legs may open.

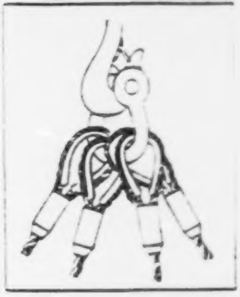
Correct
Pack the pin
with washers to center
the load on the shackle

Figure 8-14
Don't rig the load resting on
a leg of the shackle.

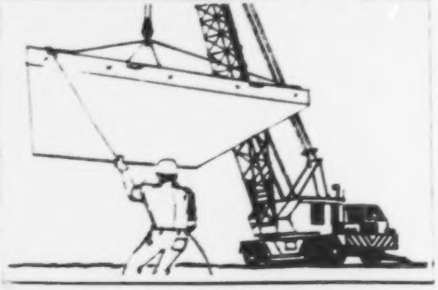
When using a screw type shackle, do not rig the load on the screw pin (Figure 8-13). If the load shifts, the pin can be unscrewed.

Do not rig a load where the main weight is resting against the leg of the shackle. Instead, pack the pin with washers or other spacing that will prevent the shackle from shifting to one side or the other as shown in Figure 8-14.

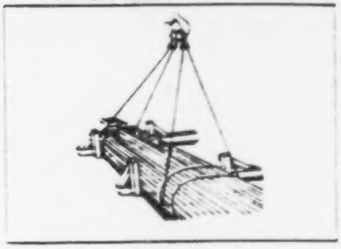
Whenever 2 or more ropes are to be Placed Over a Hook — Use a Shackle



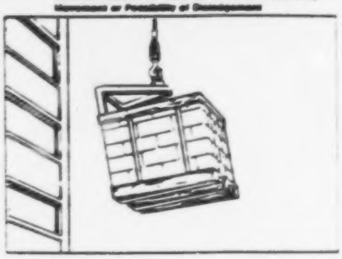
Use Tag Lines to Control All Loads



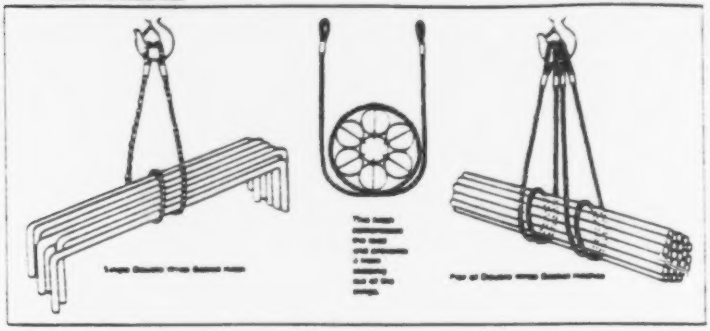
Before Being Unhooked All Loads Must Be Safely Landed and Properly Blocked



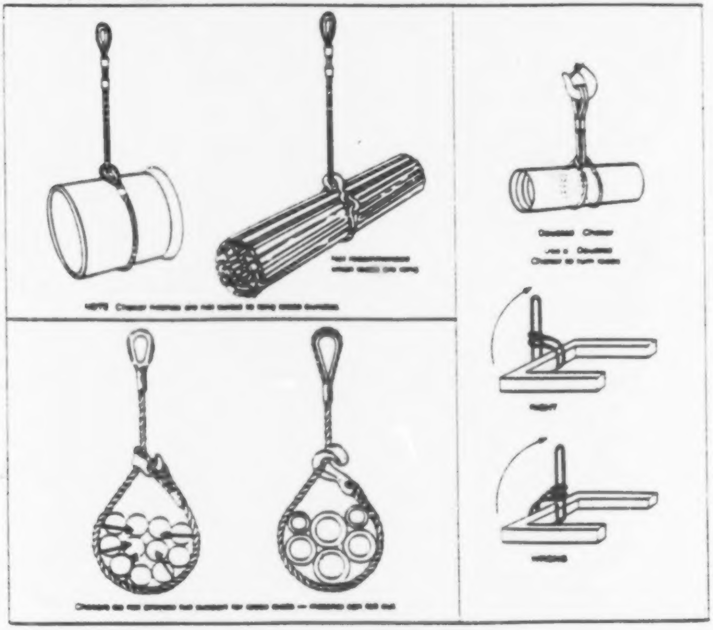
Load and Secure All Materials so as to Prevent Any Movement or Possibility of Dislodgement



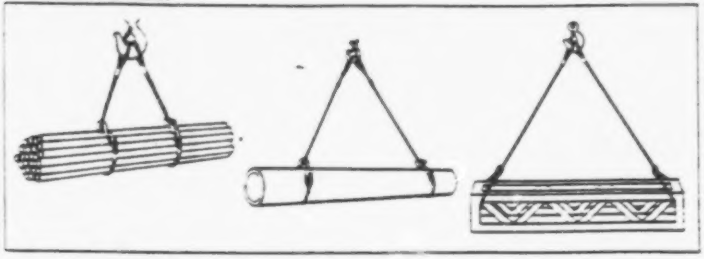
Double Wrap Basket Hitch


Single Double Wrap Basket Hitch
Pair of Double Wrap Basket Hitches

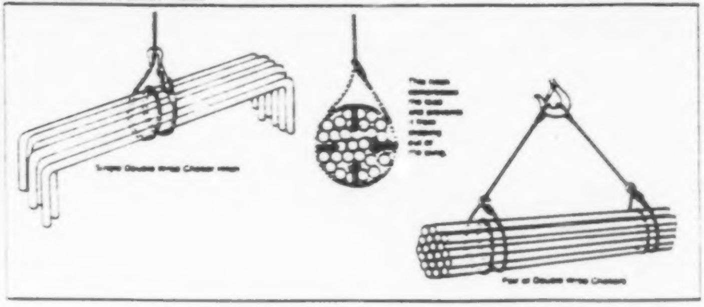
Single Choker Hitches


Not recommended when loads are long
NOTE: Choker hitches are not suited to long loose bundles.
Doubled Choker
Use a Doubled Choker to turn loads
RIGHT
WRONG

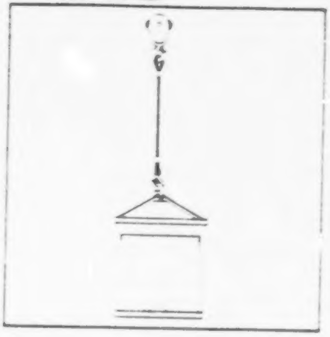
Double Choker Hitches



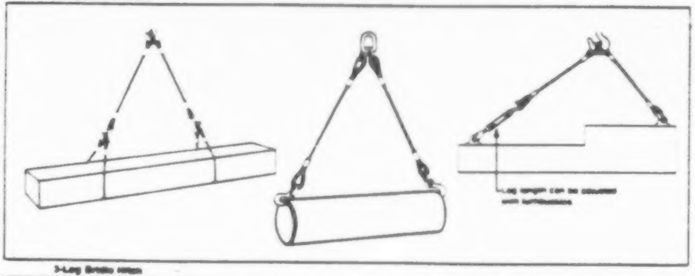
Double Wrap Choker Hitches


The hitch compresses the load and prevents it from slipping out of the sling.
Single Double Wrap Choker Hitch
Pair of Double Wrap Chokers

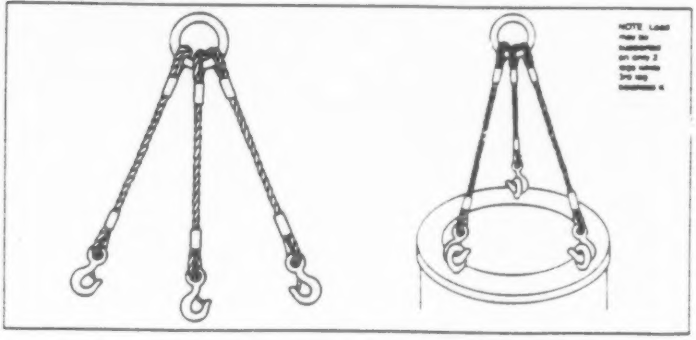
Single Vertical Hitch



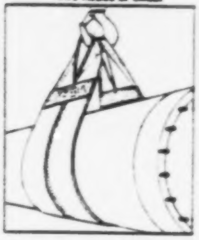
2-Leg Bridle Hitches


Leg length can be adjusted with turnbuckles

3-Leg Bridle Hitch


NOTE: Load may be supported on only 2 legs while 3rd leg balances it.

Synthetic Web Slings do not Damage or Crush Like Wire Ropes or Chain



Pipe handling illustrates the tendency of webbing slings to mold themselves to the load. This allows handling irregularly shaped loads securely.

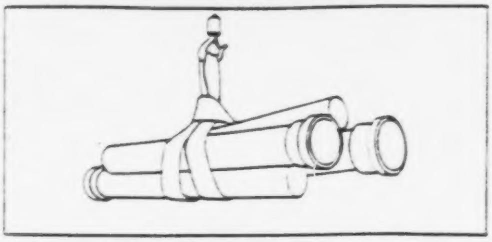


Fig. 6.24 Endless or Grommet Sling

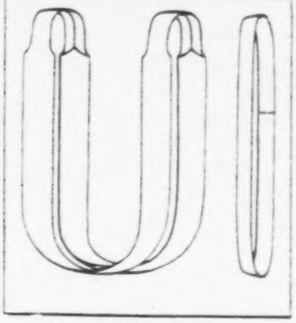
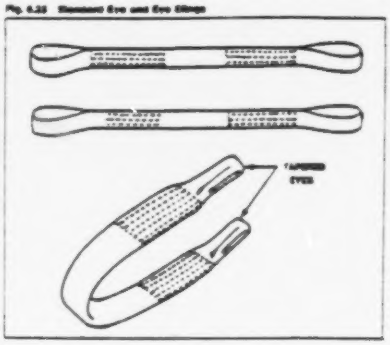
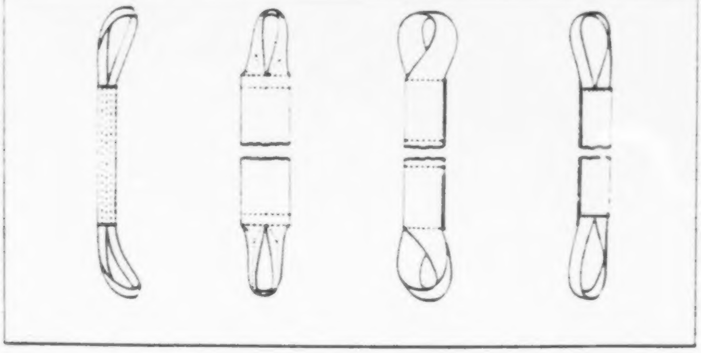


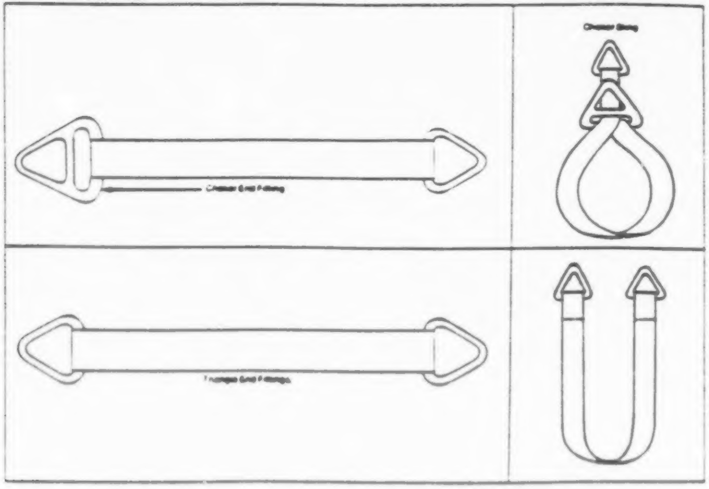
Fig. 6.25 Standard Eye and Eye Slings


TAPERED EYES

Twisted Eye Slings



Metal End Fittings


Choker Sling
Choker End Fitting
Triangle End Fittings

Fiber Rope

Fiber rope can be either natural or synthetic. Synthetic fiber is resistant to decay and it is stronger than natural fiber.

Caring For Your Rope

Keep fiber rope stored in a clean dry place to keep it from deteriorating. Do not store ropes on the floor, in boxes or cupboards where there are any air restrictions. Coil the rope on wooden pegs above the floor. Dry out a wet rope and clean it before storing it. Keep ropes away from chemicals, heat, acid, acid fumes, fumes and exhaust gases. Open the rope up to check the strands during the inspection. Sometimes the rope begins to rot from the inside-out. Do not leave any kinks behind when you unravel the rope for inspection because kinks decrease the ropes' strength. Cut the rope in half if it is not fit for use.

Natural Fiber Rope - Advantages

Natural fiber ropes are made up of plant fibers. They have three strands and each strand contains a number of threads. Only number 1 manila rope should be used for overhead lifting slings. A good grade manila rope has a whitish color and the poorer grade manila is yellowish in color. Listed below are the advantages of natural fiber rope.

- lightweight
- strong
- grips load well
- stretches less than synthetic ropes

Natural Fiber Rope - Disadvantages

- lose a lot of strength in the cold
- 5% weaker when wet
- shrink when wet
- rot
- wear out quickly
- deteriorate from the sun
- poor resistance to chemicals
- become electrical conductor when wet

Nylon Rope Slings - Advantages

- 2-1/2 times stronger than manila
- good abrasion resistance
- flexible
- good resistance to sunlight
- resistance to extreme cold
- can be braided for high breaking strength

Nylon Rope Slings - Disadvantages

- stretch
- 10% weaker when wet
- low resistance to acid
- hard to handle when wet

Polypropylene Rope Slings - Advantages

- will float
- 1-1/2 times stronger than manila
- flexible
- grips load well
- does not lose strength when wet
- resists acid and alkaline
- excellent non-conductor of electricity
- good abrasion resistance

Polypropylene Rope Slings - Disadvantages

- not as strong as nylon rope slings
- lower melting point than manila rope
- will soften under hot conditions

Rope Strength

Whenever you have to apply a knot, bend or hitch to a rope its strength will be reduced. Knots and bends cut the rope strength in about half and hitches reduce the strength by about 25 percent. Knots tend to slip on polyethylene and polypropylene rope, so you should "double up" the knots for safety.

Knots

The bowline never jams or slips when it is tied properly. It can be tied and untied easily. Two bowlines can join two ropes together. Single bowlines can be used for hoisting or hitching around a ring or post.

Hitches

The clove hitch is a quick way to fasten a rope around a post or pipe. It can be tied in the middle or at the end of a rope.

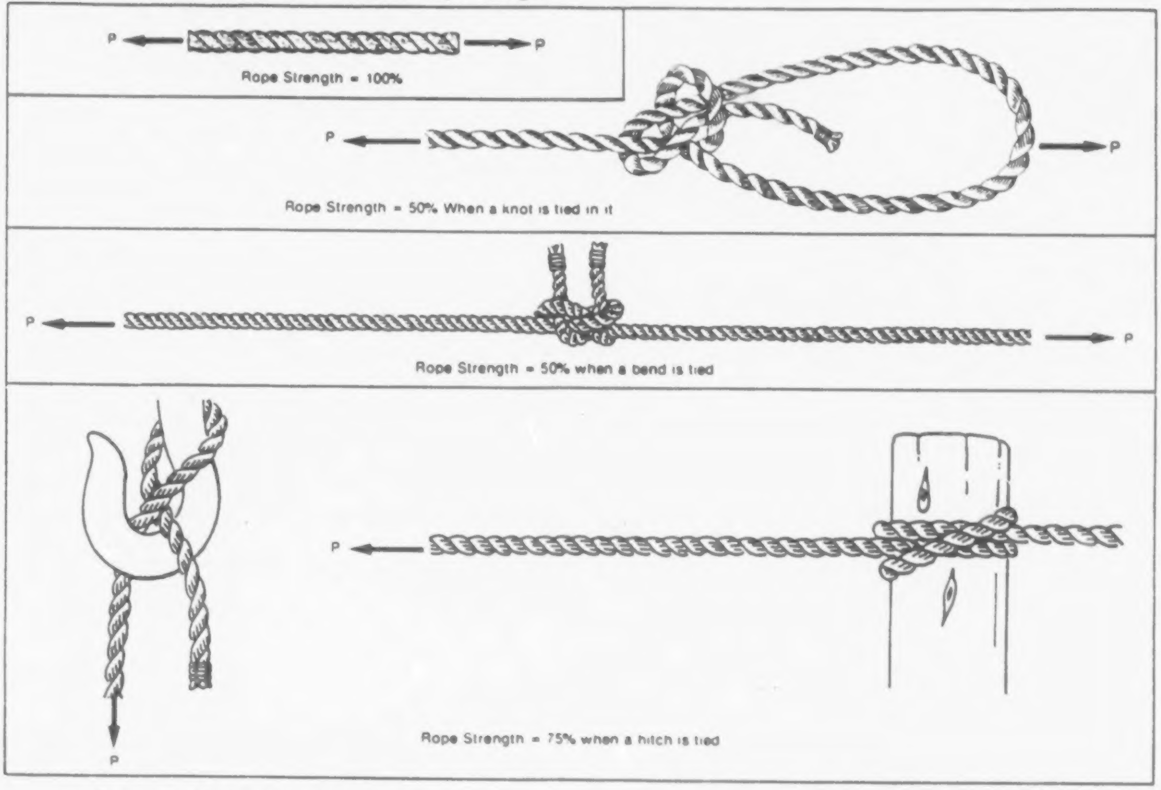
The half-hitch can be used whenever the pulling force on the rope is at right angles to the pole or tube.

The two half-hitches can be tied quickly and they are reliable for many purposes.

The timber hitch is used to lift a steady load made up of posts, planks, pipe and timber. The timber hitch does not slip or jam and loosens when the strain is taken off of it. A couple of half hitches can be added to a timber hitch to keep a plank or pipe on end when you need to lift it up.

The scaffold hitch is used by two workers to lower a single plank while keeping the plank perfectly level. This hitch should be practiced often so that you become familiar with it. It will be very, very useful to you when you have to bump planks to a lower level where no planks exist. With the scaffold hitch you will be able to lower the plank safely and you will have something to stand on before you begin lowering the rest of the plank.

Effect of Knots, Bends and Hitches on Rope Strength



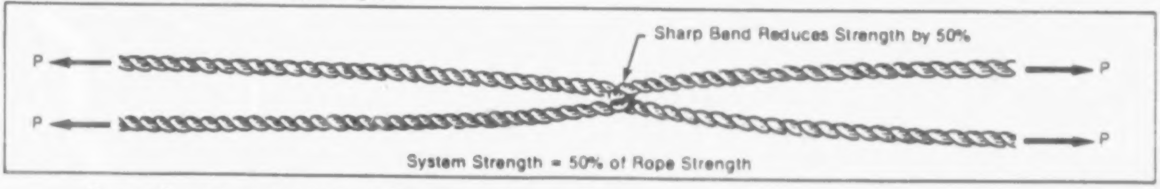
Rope Strength = 100%

Rope Strength = 50% When a knot is tied in it

Rope Strength = 50% when a bend is tied

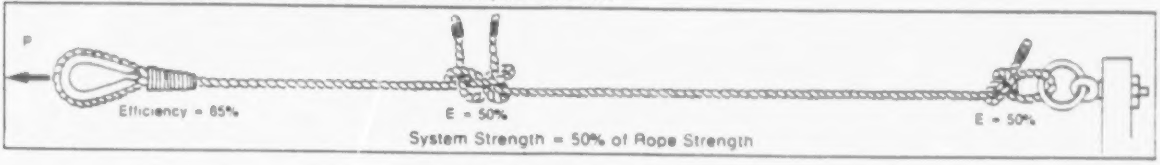
Rope Strength = 75% when a hitch is tied

Capacity of 2 Ropes Looped Together


Sharp Bend Reduces Strength by 50%
P
P
P
P

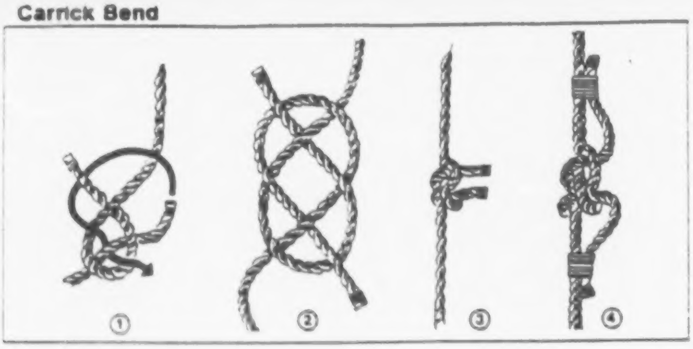
System Strength = 50% of Rope Strength

System Strength When a Series of Knots and Splices are Tied


P
Efficiency = 85%
E = 50%
E = 50%

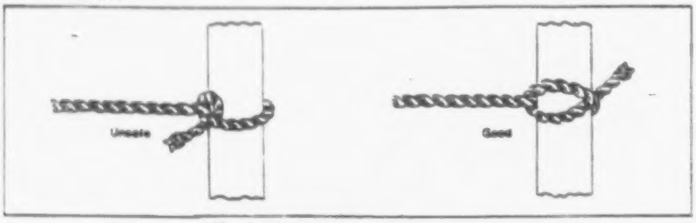
System Strength = 50% of Rope Strength

Carrick Bend



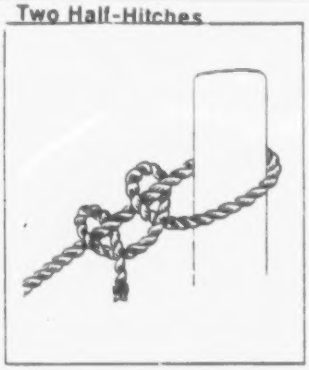
Carrick Bend: This knot can be used for joining ropes together and is easier to untie than most knots after being subjected to load. It is one of the strongest of knots, cannot jam and under load it always draws up tight which is important because very heavy ropes usual cannot be fully tightened by hand. With on rope end form an underhand loop with both the free end and standing part pointing away from you. Start the second rope end beneath both sides of the loop. Cross it over the standing part of the first rope. Then under the free end of the first rope. Then over the left side of the loop. Cross it under itself and let the second free end lie over the right side of the loop. Finish by seizing each end to the standing part.

Half-Hitch



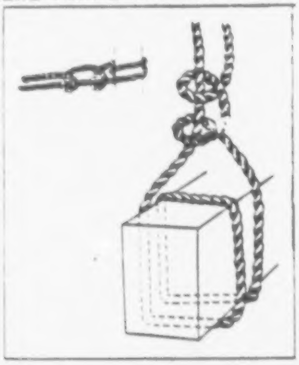
Half-Hitch: The Half-Hitch is generally used for fastening to an object for a right-angle pull. To tie, pass the end of the rope around the object and tie an Overhand Knot to the standing part. The illustration shows the Half-Hitch tied with the end nipped under the turn of the rope some distance away from the standing part; this method is fairly reliable for temporary use if the pull is steady and the arrangement is not disturbed.

Two Half-Hitches



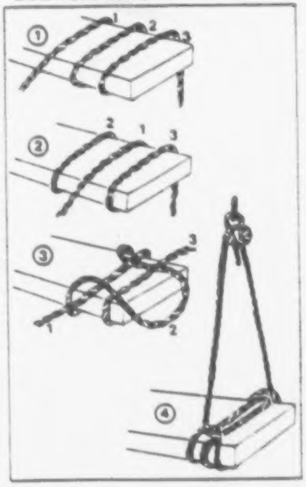
Two Half-Hitches: Just as its name states, Two-Half-Hitches is simply a Half-Hitch tied twice. It is quickly tied, reliable, can be p to almost any general use.

Round Turn & Two Half-Hitches



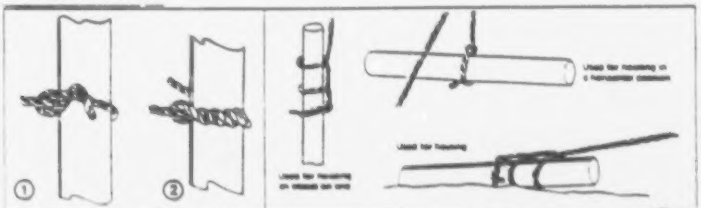
Round Turn and Two Half Hitches: Can be used to secure a rope to a column or post. It is easily tied, does not jam, and will stand heavy strains without slipping.

Scaffold Hitch



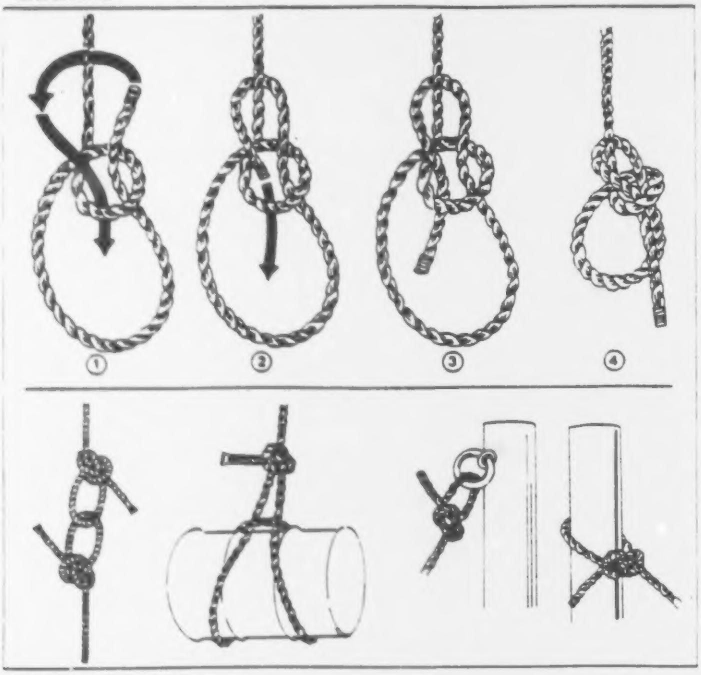
Scaffold Hitch: The Scaffold Hitch is used for fastening single scaffold planks and needle beams so that they hang level and are prevented from tilting.

Timber Hitch

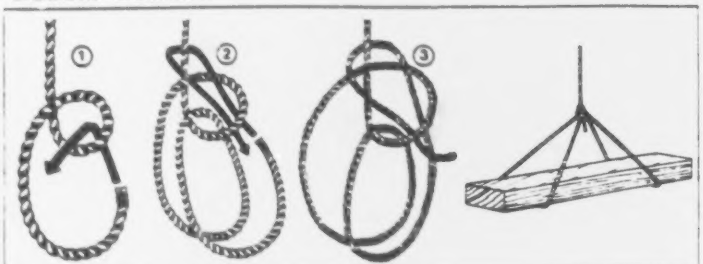


Timber Hitch: Generally used for fastening rope to posts and for hoisting planks, timbers, pipe, etc. but use it only when the load is steady. The Timber Hitch holds without slipping and does not jam but loosens when strain is relieved. One or two Half-Hitches should be added to keep a plank or length of pipe on end while it is being lifted. To tie, pass a rop around the object and take a turn with the e around the standing part. Then, as shown i the diagram, twist or turn the end back on itself. Three turns back are sufficient and they should follow the lay of the rope.

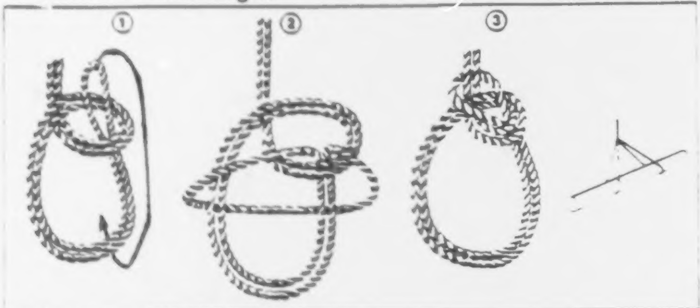
Bowline



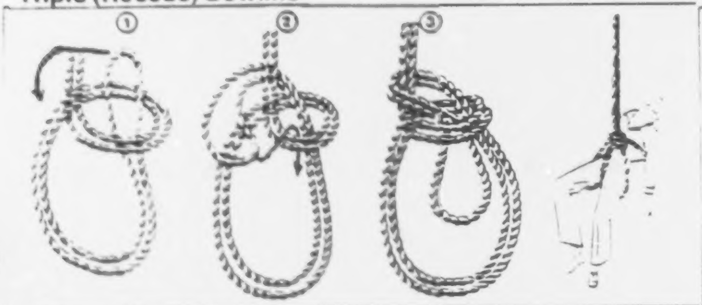
Double Bowline



Bowline on the Bight



Triple (Rescue) Bowline



Bowline: Never jams or slips if properly tied. It is a universal knot that is easily tied and untied. Two interlocking Bowlines can be used to join two ropes together, single Bowlines can be used for hoisting or hitching directly around a ring or post. Make an overhand loop with the end of the rope held toward you. Pass the end of the rope up through the loop, then up behind the standing part and back down through the loop. Draw up tight.

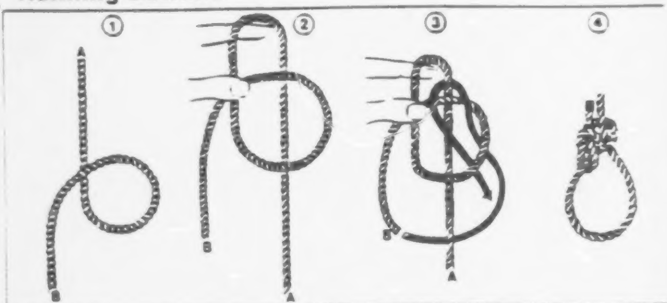
Double Bowline: Forms a good non-slipping eye or set of spreaders for a sling. Make an overhand loop with the end of the rope held toward you, exactly as for the ordinary Bowline. Pass the end through the loop twice — making two lower loops. The end is then passed behind the standing part and down through the first loop again as in the ordinary Bowline. Pull tight.

Bowline on the Bight: The knot is used to tie a Bowline in the middle of a line or for making up a set of double leg spreaders. It can also be used as a sling to sit in by sitting in one loop and putting the other loop around the back and under the arms. To tie, double the rope, make an overhand loop and pass the loop end up through it. Bring the loop end toward you, down and over the other loop section. Bring the loop up back until it lies behind the standing part. Draw it tight by a slow even pull on the upper right side as shown.

Triple (Rescue) Bowline: Is effective for lifting injured persons since a third loop is available to support the back and shoulders as well as individual loops for each leg. Double the rope, make an overhand loop and pass the loop end up through it then up and in behind the standing part and back down through the loop, thus making the third loop. Draw up tight.

Running Bowline: Makes an excellent slip knot or noose. It runs freely on the standing part, is easily untied and is very strong and efficient. To tie, make an overhand

Running Bowline



EYE OR SIDE SPLICE:

These splices are normally used to form an eye in the end of a fibre rope. The Side Splice is also called the Eye Splice because it is used to form an eye or loop in the end of a rope by splicing the end back into its own side. This splice is made like the Short Splice except that only one rope is used. Metal or nylon thimbles should be fitted to all eye splices for lifting.

Here is a step-by-step guide:

— **One:** Start by seizing the working end of the rope. Unlay the three Strands A, B and C, to the seizing and whip the end of each strand. Then twist the rope slightly to open up Strands D, E and F of the standing part of the rope as indicated. Sketch 1

— **Two:** The first tuck is as shown in the illustration. The middle strand is always tucked first, so Strand B is tucked under Strand E, the middle strand of the standing part. Sketch 2

— **Three:** The second tuck is now made. Left Strand A of the working end is tucked under Strand D, passing over Strand E. Sketch 3

— **Four:** This figure shows how the third tuck is made. In order to make Strand F easy to get at the rope is turned over. Strand C now appears on the left side Sketch 4

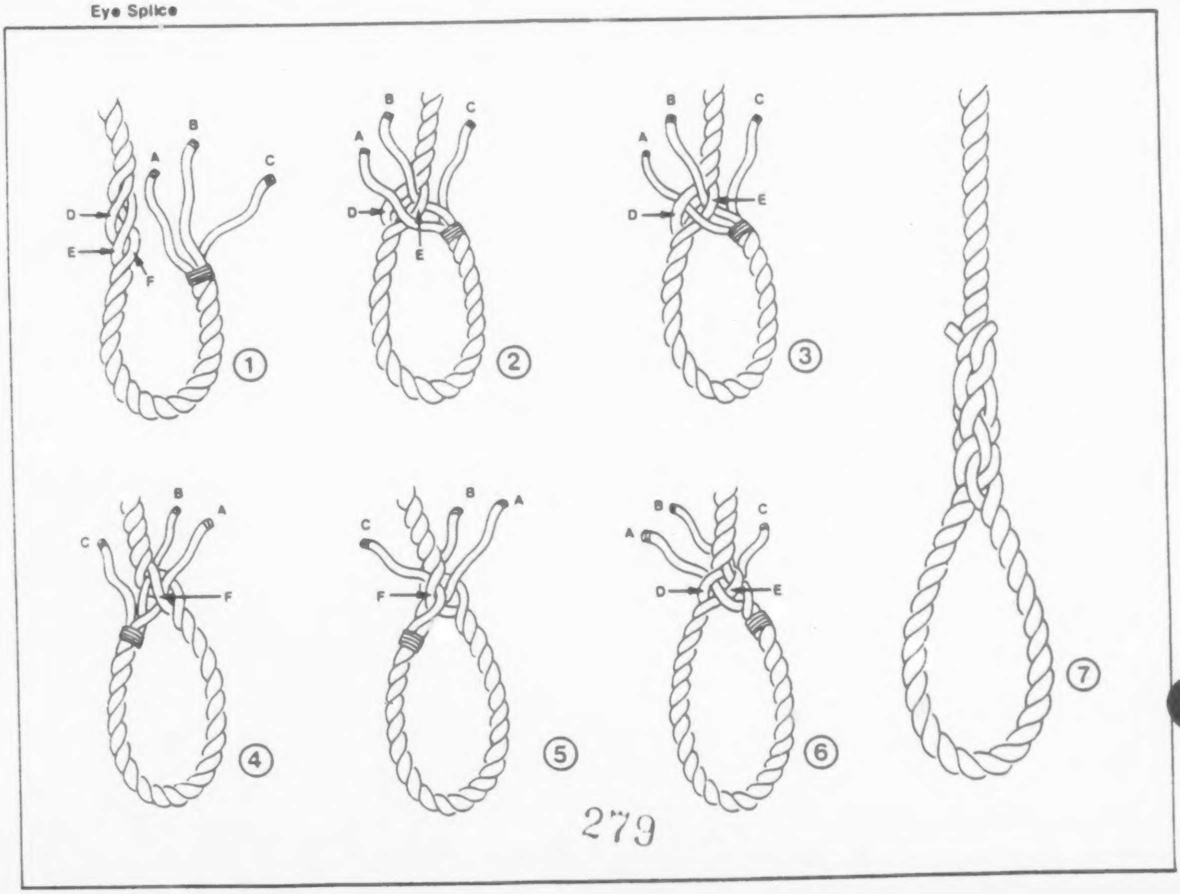
— **Five:** Strand C is then passed to the right of and tucked under Strand F, as shown. This completes the first round of tucks Sketch 5

— **Six:** This illustration shows the second round of tucks started, with the rope reversed again for ease in handling. Strand B is passed over Strand D and tucked under the next strand to the left. Continue with Strands A and C, tucking over one strand and then under one to the left. To complete the splice, tuck each strand once more. Sketch 6

— **Seven:** The finished Eye Splice is as shown. Remove the temporary seizing and cut off the strand ends, leaving at least ½" on each end. Roll the splice back and forth under your foot to even up and smooth out the strands. Sketch 7

Where metal thimbles are used in the eyes it is important to have a correct design. Synthetic fibre ropes are more extensible under load than natural fibre ropes, and under load the eye splice pulls a greater distance from the thimble end. This can result in the angular sides of the thimble losing contact with the rope at the eye. Accordingly the only bearing of rope to thimble is around the thimble radius and rocking of the thimble can occur, leading

Eye Splice



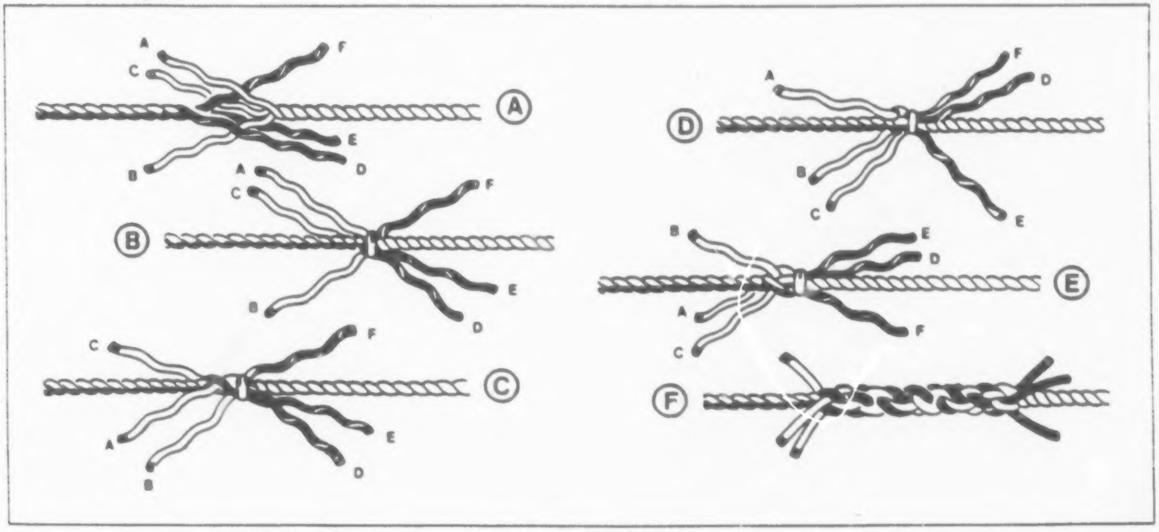
SHORT SPLICE:

The Short Splice, while the strongest of all splices, is not suitable if the rope runs over sheaves or through blocks because the diameter of the rope is almost doubled at the point of joining. They are most suitable for making endless slings, etc.

Here's a step-by-step guide to making a Short Splice:

- **One:** Unlay the strands at one end of each rope for 6 or 8 turns. The ends of the strands should be whipped to prevent their untwisting and brought together so that each strand of one rope alternates with a strand of the other rope. Sketch A
- **Two:** Bring the ends tightly together and apply a temporary seizing where they join. Sketch B
- **Three:** Take any one strand and begin tucking, the sequence being over one and under one. Strand A is passed over the strand nearest to it, which is Strand D, and then under the next strand, Strand E. Sketch C
- **Four:** Rotate the splice away from you one-third of a turn and make the second tuck. Strand B is passed over Strand E and then under Strand F. Sketch D
- **Five:** Before making the third tuck, rotate the splice again one-third of a turn away from you. Strand C is then passed over Strand F and under the next one, Strand D. Sketch E
- **Six:** This completes the first round of tucks in the left-hand half of the splice. Each strand should now be tucked at least twice more, always over one and under one as before, making sure that each strand lies snug and with no kinks.
- **Seven:** To finish the splice, reverse the rope end for end so that Strands D, E and F are now at the left instead of the right and repeat the operation on their side of the rope. Each of the six strands will now have had at least three tucks. A tapered splice is made by taking two more tucks with each strand, cutting away some of the threads from each strand before each extra tuck.
- **Eight:** When tucking is finished, remove the centre seizing and cut off the ends of all strands, leaving at least $^3/_4$" on each end. To give a smooth appearance roll the splice back and forth, either under your foot or between two boards. Sketch F

Short Splice



SECTION IX
CUTTING AND BURNING

Trainee Objectives

The trainees should learn:

1. To become aware of safety and fire hazards associated with oxy-acetylene cutting.
2. To become aware of the importance of careful handling and secure storage of cylinders.
3. How to check for leaks in regulators and hoses.
4. To become aware of the proper procedures for lighting and operating an oxy-acetylene torch.
5. Competency in setting up the cylinders, hooking up the regulators, and checking for leaks.
6. Proper procedures in lighting and adjusting the flame on an oxy-acetylene cutting torch.
7. Competency in cutting different shapes and thickness of metal such as flat stock, angles, I-beams, etc.

SECTION IX
INSTRUCTOR OUTLINE

1. Discuss use of P.P.E. for oxy-acetylene cutting and stress the importance of proper clothing.
2. Use Laborers-AGC video TIPS AV10 "Oxy-Acetylene Cutting" for segment on cutting torches. Refer trainees to Laborers-AGC Training TIPS #10.
3. Stress the importance of safety when handling cylinders and hooking up regulators, hoses, and torches.
4. Discuss area preparation for cutting operations and fire prevention.
5. Demonstrate complete procedure from setting up cylinders to lighting and using the cutting torch.

Hands-On Training

6. Start with flat stock and have trainees practice making square cuts, then beveled cuts.
7. Move on to angles, I-beams or H-beams, and channels for more difficult cutting practice.

8. Practice piercing holes and cutting circles in plate steel.
9. Practice cutting from different positions, i.e. - flat, vertical, horizontal, and overhead.

SECTION IX
OXY-FUEL CUTTING

General Safety Information

There are a number of hazards in the use of oxy-fuel cutting equipment. A thorough understanding of the proper safety and operating procedures will minimize the hazards and add to the efficiency of your cutting work.

Safety precautions in the work area should include:

1. The work area must have a fireproof floor. Concrete floors are recommended.
2. Heat-resistant shields should be used to protect nearby walls or unprotected floors from sparks and molten metal.
3. Adequate ventilation is required to prevent the concentration of oxygen, fuel gas, or toxic fumes. It is important to remember that oxygen itself will not burn, but the presence of pure oxygen will accelerate combustion, and cause materials to burn violently.
4. Work benches or tables used during oxy-fuel cutting must have fireproof tops. Fire bricks or heavy steel grating make good cutting surfaces.
5. Oxygen and fuel gas cylinders must be chained or otherwise secured to a wall, bench, or cylinder cart to protect them from falling and to hold them upright.

Safety precautions for P.P.E. should include:

1. Protect yourself from sparks, flying slag, and flame flash at all times. Goggles with tempered lenses shaded No. 4 or darker must be used to protect eyes from injury and to provide good visibility of the work.
2. Wear protective gloves, sleeves, aprons, and shoes to protect skin and clothing from sparks and molten metal. Keep all clothing and protective apparel absolutely free of oil or grease.

Safety precautions for fire protection should include:

1. Always inspect oxy-fuel equipment for oil, grease, or damaged parts. Never use oxy-fuel equipment if oil, grease, or damage is present. Clean and repair equipment before using it.
2. Never use oil or grease on any oxy-fuel equipment. Even a trace of oil or grease can ignite and burn violently in the presence of oxygen.
3. Keep flames and sparks away from cylinders and hoses.
4. Keep all combustibles well away from cutting operations as sparks can travel as far as 35 feet.
5. Keep a fire extinguisher of the proper type in the work area, inspect it regularly and know how to use it.
6. Use oxy-fuel equipment only with the gases for which it is intended.
7. An acetylene cylinder shall not be opened more than 1-$1/2$ turns and

preferably not more than 3/4 of a turn. If a cylinder wrench is needed, leave it on the valve for quick shut-off if necessary.

8. For all gases except acetylene open the cylinder valve completely to seal the cylinder back seal packing.

9. Never test for gas leaks with a flame. Use a soap solution and brush on connections to check for gas leaks.

10. When work has been completed, check the areas for possible fires or smoldering materials.

Gases Used for Oxy-Fuel Cutting

Oxygen

Oxygen is required to support any burning process. For oxy-fuel cutting it is necessary to combine oxygen with a "fuel" gas to produce the desired operating flame. Oxygen alone is not flammable, however, the presence of pure oxygen will greatly increase the speed and force with which burning takes place. Its presence can turn a small spark into a roaring flame or explosion.

Oxygen is ordinarily supplied in standard drawn steel cylinders. The 244 cubic foot cylinder is most commonly used (Figure 9-1), but larger and smaller sizes are available. Oxygen cylinders are usually pressurized to more than 2000 pounds per square inch. The amount of pressure in an oxygen cylinder will show on the high pressure gauge on the regulator.

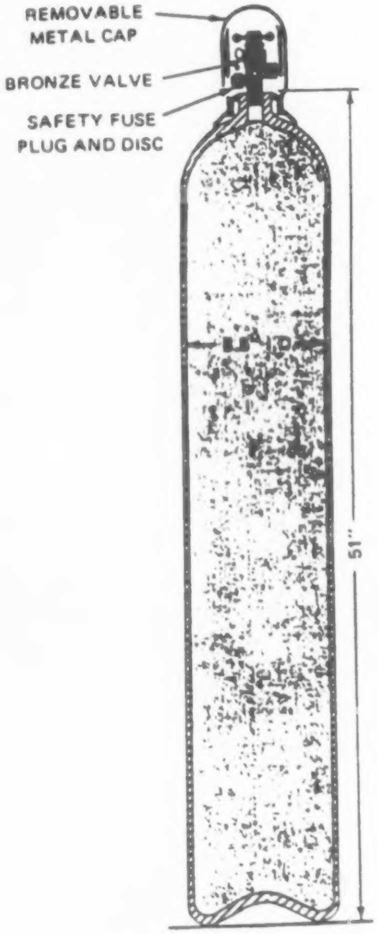


Figure 9-1
Oxygen Cylinder

WARNING

Never use oxygen:

- In pneumatic tools
- In oil preheating burners
- To start internal combustion engines
- To blow out pipelines
- To dust off clothing or work area

- To create pressure
- For ventilation

Use oxygen only for oxy-fuel cutting, heating, or welding, and always handle the cylinders with care.

Acetylene

Acetylene is a compound of carbon and hydrogen (C_2H_2). It is a versatile industrial fuel used in cutting, heating, welding and brazing applications. Acetylene is unstable when it is compressed above 15 psig in its gaseous state and cannot be stored in a hollow cylinder under high pressure like oxygen is stored. Acetylene cylinders are filled with a porous material that is saturated with liquid acetone. As acetylene is pumped into the cylinder it is absorbed by the liquid acetone throughout the porous filler and is held in a stable condition, Figure 9-2. Filling acetylene cylinders requires special equipment and training and can only be refilled by authorized gas distributors.

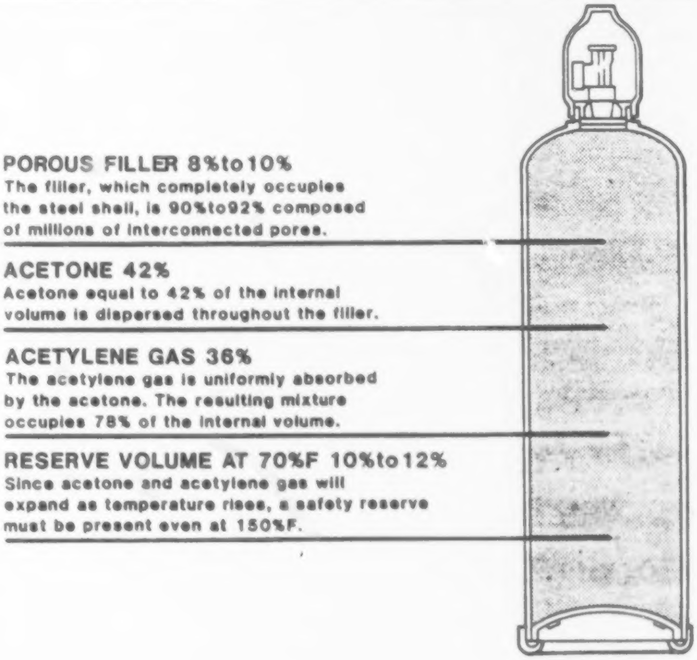

POROUS FILLER 8%to10%
The filler, which completely occupies the steel shell, is 90%to92% composed of millions of interconnected pores.
ACETONE 42%
Acetone equal to 42% of the internal volume is dispersed throughout the filler.
ACETYLENE GAS 36%
The acetylene gas is uniformly absorbed by the acetone. The resulting mixture occupies 78% of the internal volume.
RESERVE VOLUME AT 70%F 10%to12%
Since acetone and acetylene gas will expand as temperature rises, a safety reserve must be present even at 150%F.

Figure 9-2
Acetylene Cylinder Interior

Acetylene is available in cylinders ranging in size from 10 to 850 cubic feet and filled to a pressure of approximately 250 psig.

Other Fuel Gases

Mapp Gas and Liquid Air Fuel Gas are mixtures of methyl acetylene and propadiene.

Natural Gas and Propane

Natural gas is collected in oil fields and transported through pipelines and consists of approximately 93% methane. Propane is recovered from natural gas that is dissolved in crude oil and from petroleum refinery gases. It is commonly termed liquefied petroleum gas (LPG).

All fuel gases are available in a wide range of cylinder sizes and can be used as a substitute for acetylene.

Oxy-Fuel Equipment

Oxy-fuel work stations include the following items designed to perform a specific function:

1. Oxygen and fuel supply
2. Regulators
3. Hose
4. Torch handle
5. Cutting attachment and tips
6. Welding nozzles
7. Heating nozzle

Most commonly found on construction sites are portable work stations, with the oxygen and fuel cylinders mounted on a cart to be easily moved from one location to another. Always make sure the cylinders are chained to the cart and placed on level surfaces to prevent tipping and possible damage to the valves on the cylinders.

Oxygen and fuel pressure regulators are attached to the cylinders to reduce high cylinder pressures to low working pressures needed for cutting and welding operations. The parts of a regulator that the operator must be familiar with are listed below, (Figure 9-3).

1. Inlet connections - used to connect the regulator to the cylinder. Fuel gas inlet connections usually have left-hand threads and are marked with a "V" notch around the connecting nut. All oxygen connections have right-hand threads.
2. Pressure adjusting screw - controls the delivery process of the gas to the hose. Turning the adjusting screw clockwise opens the pressure valve, allowing gases to flow through the hose to the torch. Turning the pressure adjusting screw fully counter-clockwise will release the pressure on the valve and the gas flow will be cut off.
3. Pressure gauges - the high pressure gauge will show cylidner or inlet pressure. The low pressure gauge shows the pressure being delivered from the regulator to the hose.
4. Outlet connections - welding hoses are attached to the outlet connections. As with the inlet connections the fuel gas outlets and hoses have left-hand threads with "V" notches for easy identification adn oxygen outlets have right-hand threads.

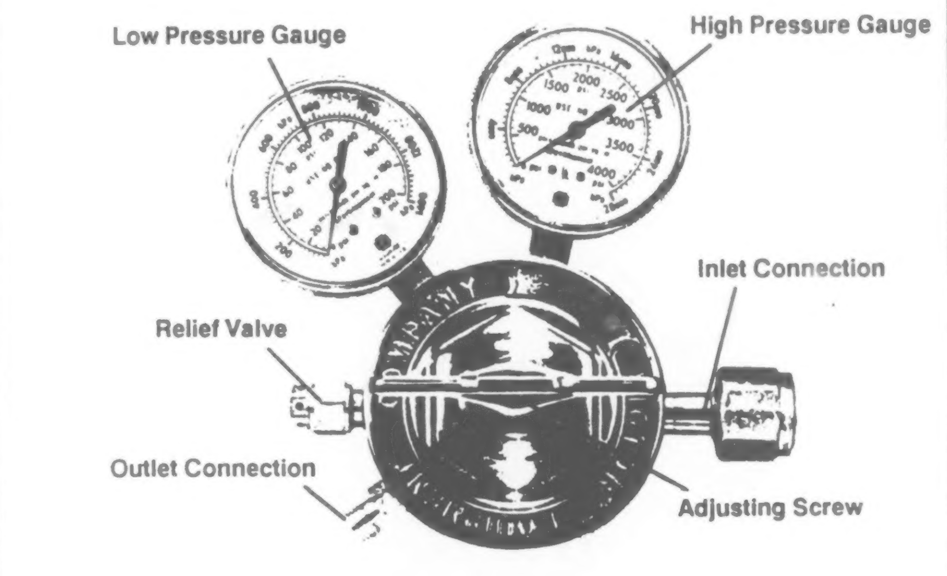


Figure 9-3
Regulator Parts

5. Relief valve - protects the low pressure side of the regulator from high pressure.

The welding hose transports low pressure gases from the regulators to the cutting or welding torch. These hoses are designed for 200 psig maximum pressure. Industrial welding hose is usually color coded for gas identification. Oxygen hose is usually green and fuel hose is red. The hose walls are constructed of layers of rubber or neoprene material over a braided inner section. All approved hose is flame retardant, it will burn but will not support a flame when the heat source is remvoed.

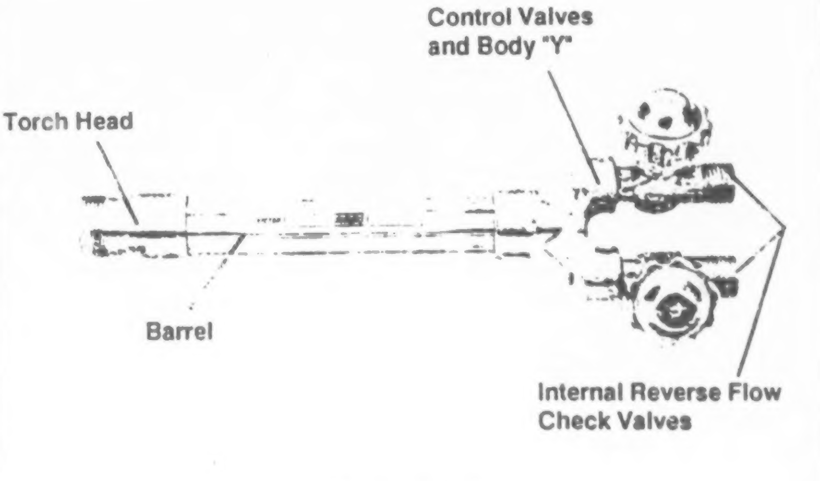

Control Valves and Body "Y"
Torch Head
Barrel
Internal Reverse Flow Check Valves

Figure 9-4
Torch Handle Parts

A torch handle is a set of gas tubes with control valves; one tube and valve controlling the fuel and the other tube and valve controlling the oxygen supply. The torch handle does not mix the gases for the oxy-fuel process, this is done by the cutting or welding attachments. The basic parts of a torch handle are listed below, Figure 9-4.

1. The control valve and body "Y" - the body "Y" is marked oxygen and fuel, and contains two control valves. The fuel sides of the body and the control valve have left-hand threads to accept the fuel gas hose and the other side has right-hand threads for the oxygen hose. These valves never require lubrication, but the packing nuts may require adjustment to prevent the valves from turning too freely.

2. The barrel and inner oxygen tube unit is designed to keep the gases separated. Oxygen moves through an inner tube while the fuel gas travels through an outer tube surrounding the oxygen tube.

3. The torch handle - threaded onto the barrel using a metal-to-metal seal. Oxygen is directed through a center hole and the fuel gas is passed through orifices drilled around the oxygen part Cutting or welding attachments contain O-rings which seat into tapered surfaces to form a gas-tight seal.

4. Internal reverse flow check valves - these valves are designed to reduce the possibility of an explosion or fire which may occur if fuel gases and oxygen become mixed inside the hoses of regulators.

The cutting attachment, when connected to a torch handle, functions as a cutting torch and provides the operator with a wide range of cutting capabilities. The parts of a cutting attachment are listed below, Figure 9-5.

1. Cone and coupling nut - designed to permit easy attachment to the torch handle. The cone end is machined to fit the torch head and sealed with O-rings to maintain separation of oxygen and fuel gas. The inner part and outer orifices match those in the torch handle and move the separated gases into the mixing chamber of the cutting attachment. Always check the O-rings for damage to prevent leaks or premature mixing of the gases which could cause backflash in the torch handle or cutting attachment.

2. Preheat oxygen control valve - controls the oxygen supply from the regulator. The oxygen valve on the torch handle must be fully open when using the cutting attachment. The fuel gas supply is controlled by the valve on the torch handle.

3. Mixing chamber tube - fuel gas and oxygen are mixed to produce the desired preheating flame. Fuel from the outer orifices and oxygen from the inner tube are directed into the mixing tube, then through the preheat orifices in the cutting attachment head to the preheat orifices in the cutting tip.

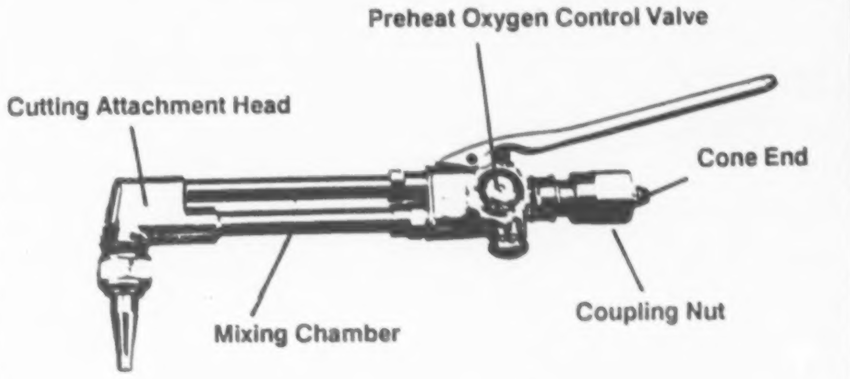


Figure 9-5
Cutting Attachment Parts

4. Cutting oxygen lever and tube - allows cutting oxygen to flow through the center part of the cutting attachment head. The upper oxygen tube is designed to allow a maximum supply of oxygen to the cutting operation and also provides structural strength for the cutting attachment.

5. Cutting attachment head - maintains separation of preheat gases and cutting oxygen during the cutting operation. The outside of the cutting attachment head is threaded for the cutting tip nut. The inside of the head has two tapered surfaces which seat the

cutting tip. The stepped design fo the two tapers allows oxygen to travel through the center part of the tip and the preheat gases pass through the the outside orifices of the tip. The tapered seating surfaces on the cutting tip provide a metal-to-metal seal when secured by the tip nut, Figure 9-6.

6. Both head and tip tapers must be inspected frequently for wear or damage to prevent fire or flashback. Cutting tips may become clogged with splatter from molten metal. Clogged orifices can be cleaned with small round files (tip cleaners). Cutting tips are sized according to the thickness of metal they can cut. Table 9-1 shows tip sizes for different thickness of metal.

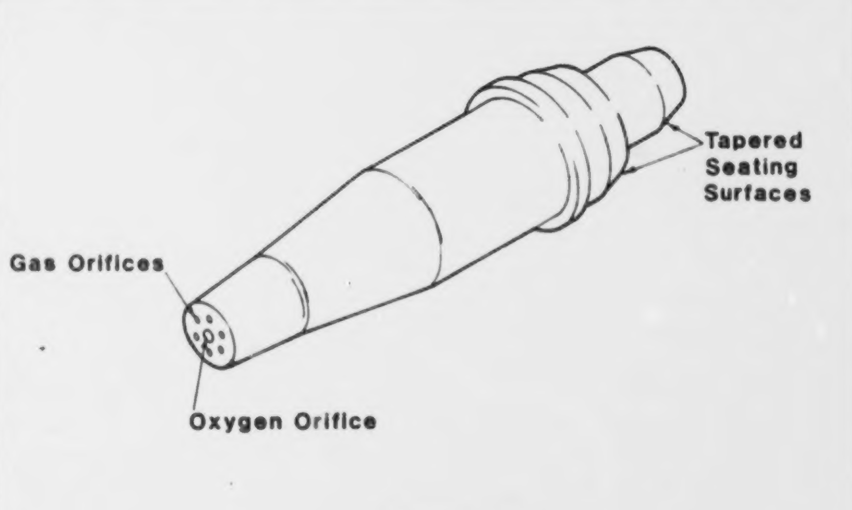


Figure 9-6
Cutting Tip

Setting Up Equipment for Oxy-Fuel Cutting

1. Chain the oxygen and fuel gas cylinders securely to the cylinder cart. Keep the valve protection caps on the cylinder cart and always replace them when moving from one job to another. Always keep cylinders in a vertical position and handle them carefully. Mark empty cylinders "empty" or "MT" and keep the valves on empty cylinders closed completely. Store full and empty cylinders in a well marked, specified storage area.

Table 9-1 Tip Selection

Metal Thickness	Tip Size	Oxygen Pressure (PSIG)	Fuel Gas Pressure (PSIG)	Travel Speed (Inches per inute)	Keft Width (In.)
1/8"	000	20-25	3-5	20-30	.04
1/4"	00	20-25	3-5	20-28	.05
3/8"	0	25-30	3-5	18-26	.06
1/2"	0	30-35	3-5	16-22	.06
3/4"	1	30-35	3-5	15-20	.07
1"	2	35-40	3-6	13-18	.09
2"	3	40-45	4-8	10-12	.11
3"	4	40-50	5-11	10-12	.12
4"	5	45-55	6-13	6-9	.15

2. Inspect the cylinder valve and regulator threads for traces of oil or grease and for any damage. Be sure the regulator has the correct pressure rating for the cylinders being used. Crack the cylinder valve (open slightly) to dislodge any contaminant that may be present. When cracking a cylinder valve always stand behind valve opening and be sure you are in a well ventilated area.

3. Attach the oxygen regulator to the oxygen cylidner and the fuel gas regulators to the fuel gas cylinder. Remember the fuel gas regulator has left-hand threads. Tighten both valves securely. Turn the regulator adjusting screws counterclockwise until all tension is released. Stand on the side of the cylinder opposite the regulator, slowly open the cylinder valve until maximum pressure is regustered on the high pressure gauge. On the oxygen cylinder open the valve compltely. On the fuel gas cylinder open the valve no more than 3/4 turn. If the fuel gas cylinder has a valve wrench, leave it on the valve so the cylinder can be turned off quickly if necessary.

   The use of reverse flow check valves is strongly recommended to reduce the possibility of mixing gases in the hoses and regulators. These check valves can be installed on the outlet fitting of the regulator and/or on the torch handle.

4. Connect the oxygen hose to the regulator and tighten securely. Open the regulator valve to 3 to 5 psig for 5 to 10 seconds to clear the hose of dust and debrist, then close the valve. Repeat this procedure with the fuel hose.

5. Inspect the torch handle head, valves and hose connections for oil, grease, or damage. Attach the hoses to the torch handle or reverse flow check valves (if used here) and tighten securely.

6. Inspect the cutting attachment, especially the O-rings that make the seal in the torch handle head and the tapered seating surfaces that make the seal for the cutting tip. If these seals are in poor condition backfire or backflash could occur. Connect the cutting attachment to the torch handle and tighten the coupling nut, hand tight only. Wrench tightening will damage the O-rings.

7. Select the correct size tip for the thickness of metal to be cut. Inspect tip into cutting attachment head and tighten the tip nut securely. Refer to Table 9-1.

Preparing to Light the Cutting Torch

1. Open the oxygen valve on the torch handle completely.

2. Open the preheat oxygen control valve on the cutting attachment and adjust the oxygen regulator to the desired pressure, then close the preheat valve.

3. Open the fuel control valve on the torch handle and adjust the fuel regulator to the desired pressure, then close the valve.

4. Purge the cutting oxygen passage by momentarily depressing the cutting oxygen lever.

5. Test all fitting and hose connections for leaks with soapy water, watching for bubbles. If bubbling occurs, tighten fitting and recheck.

6. Test hose for leaks by submerging in water.

Lighting the Torch

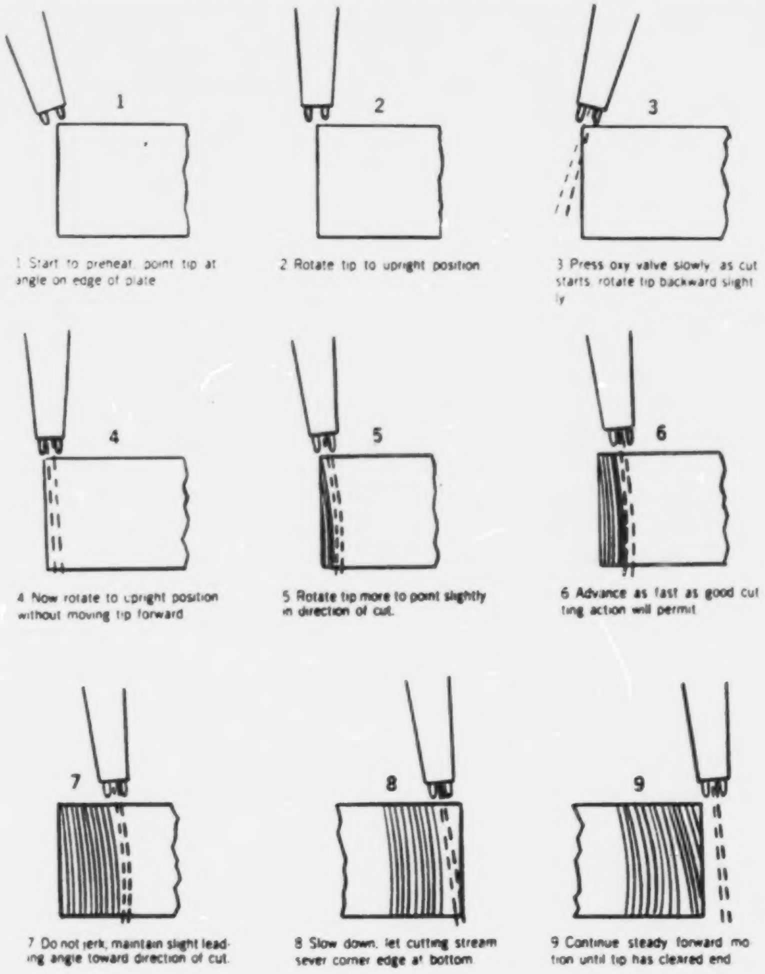
1. Open the fuel valve on the torch handle approximately 1/8 turn and ignite the gas with a spark lighter. Hold the spark lighter alongside the torch tip, not directly over the end of it. Never light the torch with matches or butane lighter.
2. Increase the fuel supply until the flame stops smoking.
3. Slowly open the preheat oxygen valve on the cutting attachment until the preheat flames form a well defined blue-white inner cone. This is called a natural flame.
4. Depress the cutting oxygen lever and readjust to a neutral flame using the preheat valve.

Cutting Procedures for Steel Plate

1. Before the oxygen can cut, the metal must be preheated to a bright cherry red. Always use both hands to guide and stabilize the cutting torch.
2. Hold the tip of the preheat flames about 1/8 inch from the metal where the cut is to begin with the tip angled toward the direction of cut.
3. As metal turns bright red, rotate tip slightly away from the direction of the cut and depress cutting oxygen lever.
4. As cutting starts, slowly rotate tip toward the direction of the cut and advance as fast as cutting will allow. Moving too fast will lose the cut and moving too slowly the will cause the cut to fuse together.
5. Holding the cutting oxygen lever, continue cutting past the edge of the metal to complete the cut (Figure 9-7).

Start a Cut by Piecing

1. Preheat a small spot on the base metal to a bright cherry red.
2. Tilt the torch slightly to one side to prevent sparks and slag from blowing toward you and depress the cutting oxygen lever.
3. When metal is pierced through move the torch in the direction you wish to cut, Figure 9-8.



1 Start to preheat, point tip at angle on edge of plate

2 Rotate tip to upright position

3 Press oxy valve slowly, as cut starts, rotate tip backward slightly

4 Now rotate to upright position without moving tip forward

5 Rotate tip more to point slightly in direction of cut.

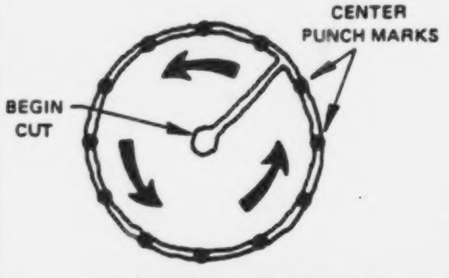
6 Advance as fast as good cutting action will permit

7 Do not jerk, maintain slight leading angle toward direction of cut.

8 Slow down, let cutting stream sever corner edge at bottom

9 Continue steady forward motion until tip has cleared end

Figure 9-7
Efficient Flame Cutting of Steel Plate



Cut from Center Outward to Rim

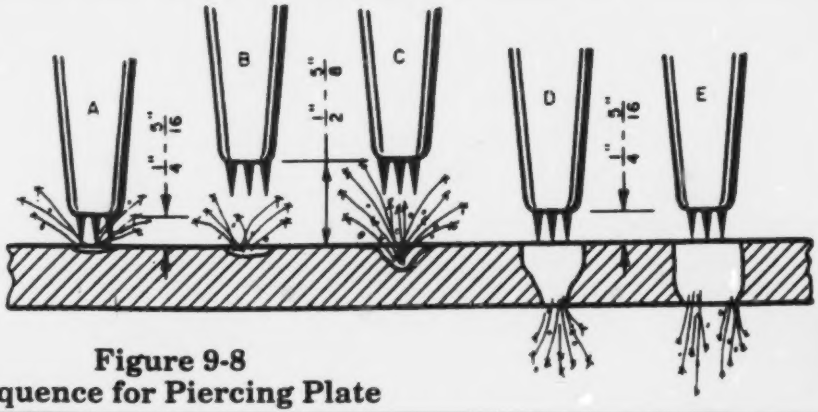


Figure 9-8
Sequence for Piercing Plate

Shutting Off the Cutting Torch

1. Close the preheat oxygen valve first, then close the fuel valve on the torch handle. If the fuel valve is turned off first a "pop" may occur which throws soot back into the torch tip causing clogging problems.

2. Close both cylinder valves.

3. Open the preheat oxygen valve or the cutting oxygen lever to release the pressure in the system. Both gauges should go to zero.

4. Close all oxygen valves and turn adjusting screw on oxygen regulator counter-clockwise until tension is released.

5. Open fuel valve on torch handle and release pressure, close valve.

6. Turn fuel regulator adjusting screw counterclockwise until tension is released.

13. Name 3 important things you should know before you make a lift?

____

____

____

14. How many wires per strand are found in a 6x19, 1/2" wire rope?

    a. 6

    b. 19

    c. 25

    d. 13

15. When a wire rope is threaded through a wedge and socket, how far should the dead end stick out of the socket?

    a. 5 - 8"

    b. 6 - 9"

    c. 7 - 10"

    d. 8 - 11"

16. How far apart are cable clips placed when installing them around a thimble?

    a. 1"

    b. 2"

    c. 3"

    d. 4"

17. How many foot - pounds should the nuts be tightened on a u - bolt attached to a 1/2" wire rope?

    a. 55 ft - lbs

    b. 65 ft - lbs

    c. 75 ft - lbs

    d. 85 ft - lbs

18. As the sling angle from the horizontal increases, (actual angle becomes smaller) the lifting capacity __________?

    a. increases

    b. decreases

    c. stays the same

19. The i.d tag on a 5/8" wire rope is missing and no chart is available to tell you the S.W.L.. Using the formula you learned, what is the S.W.L. of the wire rope?

20. What is the formula for a safe working load on a three leg bridle hitch?

21. According to the following information, what is the total S.W.L. for a 4 leg bridle hitch?

    - You will be using 1/2" wire rope slings to make the lift. (S.W.L. of one vertical leg is unknown)

    - Height from hook to load is 8 feet.

    - Length of sling from load to hook is 9 feet.

    Use the following formulas:

    1) S.W. L. (1 leg) = 1/2 x 1/2 x 8

    2) TOTAL S.W.L. = S.W.L. (1 leg) x H/L x 2

22. List four things that influence the process of soil compaction:

____

____

____

____

23. When compacting soil you are concerned with three types of soil. Name these soil types:

____

____

____

24. What two things happen when soil is compacted?

____

____

25. Which compactor would work best when compacting clay soils?

a. vibrating plate compactor

b. vibrating roller compactor

c. rammer compactor (wacker)

d. non-vibrating roller compactor

26. The right amount of moisture in the soil acts as a ____________ on the soil particles.

a. pump

b. filler

c. lubricant

d. guide

27. In order to get the best compaction while backfilling, what should be the height of each lift ?

   a. 12" - 18"

   b. 9" - 15"

   c. 4" - 16"

   d. 6" - 12"

28. When preparing a work area for oxy-fuel cutting operations, what are three safety precautions that should be taken?

29. List five safety precautions for fire protection during oxy-fuel cutting operations.

30. Oxygen should never be used:

   a. to blow out pipelines

   b. to start gasoline engines

   c. to dust off equipment or work area

   d. for ventilation

   e. for all of the above

31. A common pressure setting for oxy-fuel cutting for metals from 1/4" to 1/2" thick would be:

   a. 17 psi on fuel gauge and 35 psi on oxygen gauge

   b. 8 psi on fuel gauge and 60 psi on oxygen gauge

   c. 13 psi on fuel gauge and 45-50 psi on oxygen gauge

   d. 6 psi on fuel gauge and 25 psi on oxygen gauge

32. As fuel and oxygen flow through the regulators and hoses, they are mixed when they reach ____________________ :

   a. The torch handle

   b. The torch head

   c. The lower tube on the cutting attachment

   d. The cutting attachment head

33. When selecting a torch tip for cutting different thickness metals, which tip would be used for cutting 1/2" metal.

   a. No. 4

   b. No. 2

   c. No. 0

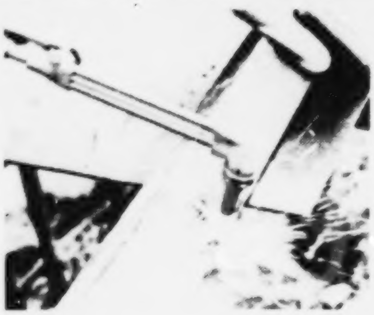
   d. No. 000

LABORERS-AGC TRAINING TIPS

No. 10

TRAINEE INFORMATION PROFILE SERIES

OXY-ACETYLENE CUTTING



Oxy-Acetylene equipment has several uses on the construction site. It can be used for cutting rebars, iron and steel. Special precautions must be taken before, during and after using this equipment to prevent accidents.

This manual is designed as a supplement to the video "BASIC OXY-ACETYLENE CUTTING" and to the hands-on training you will receive at your local training site. We have highlighted the main points to remember. Your instructor will see that you get additional information.

When you complete your training, this book will serve as a reminder of what you've learned. If you put all the information received during your training into practice on the job, you will benefit your Union, your Employer and most of all YOURSELF.

PLANNING = SAFETY

The oxygen and acetylene tanks should be stored separately with their caps on. They should be away from heat and stored upright where they won't be hit or knocked over. This helps protect the valves from damage and possible leaks or explosions. The cylinders should be handled carefully. If they are banged together or handled improperly, they could explode. Chain both cylinders securely to their hand truck before moving them.

Using the torch requires planning and this means taking along everything you will need to perform the job correctly. The list should include:

- cutting torch,
- special wrench or wrenches - for the coupling,
- goggles - to protect your eyes,
- leather welding gloves - to protect your hands,
- safety striker - to light the torch,
- soapstone and straightedge - for marking,
- soapy solutions and a brush - to check for leaks,
- tip cleaners - to clean the tip of the torch if it becomes plugged,
- a bucket - for water to control fire hazards and to check the hoses for leaks,
- a fire extinguisher,
- a leather apron to protect you from sparks,
- a long-sleeve shirt, cuffless pants and high-top shoes are also recommended to protect you from sparks.

Your clothes, gloves and work area should be free from all oil and grease.

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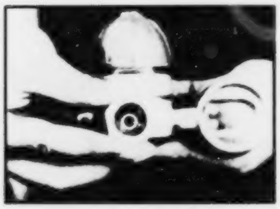
CYLINDER SET-UP

The cylinders should be positioned away from the work area, but close enough to reach them quickly if necessary. Keep the area clear between you and the cylinders. Move away any nearby drums or other containers; they may contain vapors which could explode.

Remove the caps from the tanks that protect the brass valves. If the valves are damaged the quick release of the gas in the cylinders would cause it to react like a missile or rocket, possibly injuring you or fellow workers.

The outlet valve on the acetylene cylinder should point away from the oxygen cylinder. Stand to the side of the tanks and crack the valve on the acetylene cylinder to blow out any dust or dirt.

Using a clean cloth, wipe the inside and outside of all valves and couplings to be sure they have no oil, grease, or dirt on them. Then crack the oxygen valve. Always use extra care with brass fittings. Check the regulator seats for nicks and burrs which could prevent a proper coupling.

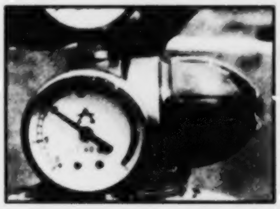


Next, attach the regulator flashback preventer and hose to the oxygen tank. These have right hand or clockwise threads. Brass fittings should be hand tightened first, then wrench tightened. Connect the acetylene regulator, flashback and hose fittings. They have left-hand or counter-clockwise threads indicated by a notch in the nut. **Remember, Red Hose-acetylene; Green Or Black Hose-oxygen.**

Prior to opening the tank, release the adjusting screw on the oxygen regulator by turning it counter-clockwise. Standing to the side of the tank, slowly open the valve. Partially open the torch oxygen valve. The top gauge should read about 2200-2400 psi full. Adjust the oxygen regulator until the pressure on the bottom gauge matches that listed for the tip you're using. Then close the torch oxygen valve.

Prior to opening the tank, release the adjusting screw on the acetylene regulator by turning it counter-clockwise. Standing to the side of the tank, slowly open the valve. Partially open the acetylene valve on the torch. The top gauge should read about 250 psi full. Adjust the regulator pressure.

Caution: Never Set The Working Acetylene Pressure Higher Than 15 Psi; it could explode.



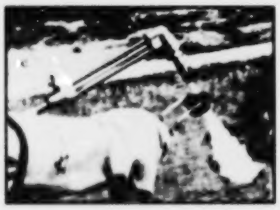
Close the torch acetylene valve. Then do the soap-and-water test for leaks. Brush the soapy water on all fittings, watching for bubbles. If bubbles appear, tighten the fitting, and check again for leaks. Wipe off the valves. Use the bucket of water to check the hose for leaks. Never try to repair a hose that leaks. Report this to your foreman.

Check your pressures once more. If they are slightly higher than when you set them, this is normal because pressure will rise somewhat when the torch is closed. All pressures on welding and cutting charts are flowing pressures with the torch valves open.

MAKING THE CUT

If you need to make a straight cut, it helps to make a guideline with your soapstone and straightedge.

First put on your safety goggles and your gloves. Open the torch acetylene valve about 1/4 turn or until you hear a hissing sound. Using a safety striker, light the torch. **Never Use Anything Else To Light The Torch.**



Adjust the flame so it just clears the end of the tip. Slowly open the oxygen valve until you get a neutral flame, in other words, one with sharp inner cones.

Next, depress the oxygen cutting lever. Then, re-adjust the oxygen valve until the flame is again neutral and release the oxygen cutting lever. Make sure what you're cutting is secured and that the hoses are out of the way.

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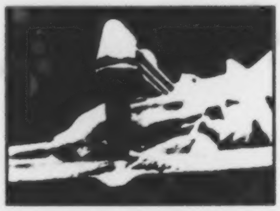
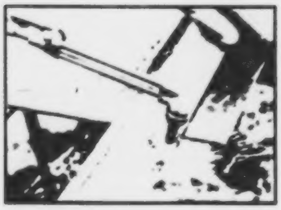
When cutting, the flame should be held close to the metal. Practice will help you determine how far you should hold the torch away from the metal. Preheat the metal to a bright cherry red. Then depress the oxygen cutting lever.





A shower of sparks indicates you are cutting through the metal. If you depress the oxygen cutting lever before the metal turns bright red, the preheated area will cool off and must then be reheated before it can be cut.

Avoid getting the torch tip too close to the metal as the cut is being made. This could damage the tip. Follow the desired line, or hold the torch at a right angle for a straight cut. Remember, use real care in handling metals that have just been cut. If it is still hot and there's a chance that other workers may handle it, write "HOT" on it with your soapstone.

If possible, steady the torch by holding it with both hands and resting your elbow.

Note: It is not recommended practice to cut into any used drums. If it is necessary please use caution. Before cutting any drums or other containers that might have held gas or oil, first clean them out with soap and water. Then re-fill them nearly full of water. This will get rid of fumes that could cause an explosion.

SHUT DOWN

When you are through cutting, shut off the torch oxygen valve and the torch acetylene valve.

Next, close the acetylene valve, then, the oxygen valve. Open the torch oxygen valve and release the oxygen in the lines. Release the adjusting screw on the oxygen regulator by turning it counter-clockwise.

Open the torch acetylene valve and release the pressure in the lines. Release the adjusting screw on the acetylene regulator by turning it counter-clockwise.

Put the gauges in the cart tray and coil the hoses around the cart handle. If a tank becomes empty, clearly mark it "MT" and return it to the storage area. If a tank has a leaking valve that can't be shut off, take care of this danger immediately. Mark it "BAD VALVE" - then take the tank to an open area away from everybody.

Open the valve completely and stay nearby to keep people away for the short time it takes the tank to empty. Report this and all empty cylinders to your foreman.

Remember: when working around materials that can burn, particularly when working inside, sparks from your work can smolder unnoticed and possibly burst into flames later. So, 1/2 hour after you're finished cutting, check the area where you have worked, especially in cracks or other hidden areas. Wet down any smoldering sparks.

Follow the steps outlined earlier for transporting and storing the tanks. Keep them separate and secured in an upright position. Make sure the caps are on and place them away from heat or areas where they could be knocked over.

Using the oxy-acetylene equipment requires practice. You can make the grade and be in demand as a top oxy-acetylene operator if you develop your skills and follow thé proper safety precautions.

KEY POINTS TO REMEMBER

- HANDLE AND STORE CYLINDERS CAREFULLY AND SECURELY.
- NEVER SET THE WORKING ACETYLENE PRESSURE HIGHER THAN 15 PSI.
- RED HOSE - ACETYLENE; GREEN OR BLACK HOSE - OXYGEN.
- ALWAYS USE A SAFETY STRIKER TO LIGHT THE TORCH.
- FLAME SHOULD JUST CLEAR THE END OF THE TIP.
- PREHEAT METAL TO A BRIGHT CHERRY RED.
- AVOID GETTING TIP TO CLOSE TO METAL.
- BEWARE OF SPARKS DURING AND AFTER CUTTING.
- USE CARE IN HANDLING METALS THAT HAVE JUST BEEN CUT.
- NEVER TRY TO REPAIR A HOSE THAT LEAKS.
- TAKE LEAKING VALVES TO OPEN AREA, EMPTY TANK AND MARK "BAD VALVE".
- NEVER USE OIL OR GREASE ON A REGULATOR OR FITTING.

General Occupational Safety and Health Regulations
Basic Oxy-Acetylene Cutting

ITEM	REFERENCE
Personal Protective Equipment (Head, Foot, Hand, Hearing, Eye/Face, Respiratory)	29CFR 1926.28
Hazard Communication	29CFR 1926.59
General Safety and Health Requirements	29CFR 1926.20
Safety Training and Education	29CFR 1926.21
Gases, Vapors, Fumes, Dust and Mists	29CFR 1926.55
Gas Welding and Cutting	29CFR 1926.350
Fire Prevention - Welding and Cutting	29CFR 1926.352
Ventilation and Protection in Welding, Cutting and Heating	29CFR 1926.353
Welding, Cutting and Heating in ways of preservation coating	29CFR 1926.354

Additional standards may apply when used in special construction activities such as demolition or tunnels and shafts.

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SECTION X
INTRODUCTORY INDUSTRY MATH

Trainee Objectives

Trainees should learn:

1. To make calculations using the U.S. customary system.
2. To make calculations using the decimal system.
3. To convert from U.S. customary system to decimal system.
4. To convert from metric measurements to U.S. customary measurements using multipliers.
5. To identify horizontal and vertical measuring equipment.
6. To set up and use horizontal and vertical measuring equipment.

SECTION X
INSTRUCTOR OUTLINE

1. Explain the U.S. standard system as used in construction. Show calculations with feet, inches, and fractions. Have trainees work exercises.
2. Explain the decimal system as used in construction. Show calculations with feet, tenths, and hundredths. Have trainees work exercises.
3. Explain conversion methods between the U.S. standard system and the decimal system. Show examples of conversion from one system to the other and have trainees work exercises.
4. Review the metric system and make conversions from metric to U.S. standard system using multipliers. Demonstrate examples using multipliers and have trainees work exercises.
5. Discuss squaring methods used in construction. demonstrate that structures with equal diagonals are square and show calculations for figuring the diagonals of a square and a rectangle. Have trainees work exercises.
6. Discuss horizontal measuring techniques and equipment. Explain and demonstrate how to make horizontal measurements using a tape measure, rag tape, 6' folding rule, and plumb bob. Stress accuracy.

7. Display vertical measuring equipment to include:

   a. builder's level
   b. transit
   c. auto level
   d. laser level
   e. hand level (pea gun)

8. Describe uses of each type of instrument. Demonstrate set-up and leveling of each instrument, focusing, reading, and recording shots from grade rod. Have trainees practice set-up and leveling of each instrument. Practice should include:

   a. Proper set-up of tripod and mounting of instrument.
   b. Leveling of instrument.
   c. Focus and fine adjustments on instruments.
   d. Plumbing of transit and how to shoot line.
   e. Reading of grade rod using builder's level, auto level, and laser level.
   f. How to use a hand level (i.e., for grade checking).

9. Practice different leveling using bench marks. Show trainees how to obtain height of instrument and calculate new elevation. Practice using the following procedure:

   a. Set-up and level instrument.
   b. Shoot and record grade rod reading at B.M.
   c. Figure and record height of instrument (H.I.)
   d. Take shots at several locations both higher and lower than B.M.
   e. Make calculations and record new elevations for each shot.

10. This exercise is intended to introduce trainees to the use of leveling instruments and differential leveling. More advanced instrument use is presented in each of the specific trade courses (i.e., Concrete, Pipelaying, etc.)

INSTRUCTOR ANSWER SHEETS
SECTION X: CONSTRUCTION MATH

Answer sheet for exercise 1: Add or subtract the following measurements.

a. 1/8" + 5/8" = **3/4”**
b. 1/4" + 3/4" = **1"**
c. 1 5/8" + 1 1/8" = **2 3/4”**
d. 1/2" + 3/8" = **7/8”**
e. 3/8" + 3/4" = **1 1/8”**
f. 3 3/4" + 2 1/4" = **6"**
g. 3/4" - 1/4" = **1/2”**
h. 5/8" - 3/8" = **1/4”**
i. 7/8" - 1/4" = **5/8”**
j. 1 3/4" - 1 1/8" = **5/8”**
k. 2 7/8" - 1 1/2" = **1 3/8”**
l. 3 5/16" - 1 3/4" = **1 9/16”**

Answer sheet for exercise #2: Work the following problems without a calculator and round the answers to 3 decimal places.

Add the following figures. Be sure that the decimal point is in the correct place.

1. 5.66 + 20.75 + 16.03 = **42.440**
2. 10.95 + 3.06 + 9.47 = **23.480**
3. 3.958 + 24.976 + 21.954 = **50.888**

Subtract the following:

1. 5.13 - 4.01 = **1.120**
2. 12.28 - 6.67 = **5.610**
3. 106.29 - 0.66= **105.630**

Multiply the following:

1. 5.16 x 1.5 = **7.740**
2. 3.1 x .05 = **0.155**
3. 1.3 x 2.51 = **3.263**

Divide the following and place the decimal point in the proper place:

1. 505.5 ÷ 50. = **10.110**
2. 50.9 ÷ 15. = **3.393**
3. 56.7 ÷ 2.5 = **22.680**

Answer sheet for exercise 3: Use a calculator to work the following multiplication and division problems; round your answer to 2 decimal places.

Multiplication	Division
1. 1034.67 x 201 = **207,968.67**	1. 5826 ÷ 6.5 = **896.31**
2. .51 x 21 = **10.71**	2. .25 ÷ .5 = **0.50**
3. 1.21 x .09 = **0.11**	3. 4.58 ÷ 1.5 = **3.05**
4. 6.18 x 1.16 = **7.17**	4. 100.13 ÷ .25 = **400.52**
5. 635.5 x 1.01 = **641.86**	5. 341.4 ÷ 2.7 = **126.44**
6. 195.5 x 10.3 = **2,013.65**	6. .369 ÷ .80 = **0.46**
7. 64.555 x .50 = **32.28**	7. 5694.45 ÷ 54.4 = **104.68**

Answer sheet for exercise 4: Use the conversion table on page 20 to convert the following U.S. Standard expressions to decimal expressions:

1. 1/8" = **.01**
2. 1" = **.08**
3. 5" = **.42**
4. 11" = **.92**
5. 7/8" = **.07**
6. 8" = **.67**
7. 1/2" = **.04**
8. 3" = **.25**
9. 3/8" = **.03**
10. 9" = **.75**
11. 6" = **.50**
12. 3/4" = **.06**
13. 12" = **1.00**
14. 2" = **.17**
15. 1/4" = **.02**
16. 7" = **.58**
17. 10" = **.83**
18. 5/8" = **.05**
19. 4" = **.33**
20. 1'-3" = **1.25**

Answer sheet for exercise 5: Convert the following to feet, tenths, and hundredths.

a. 2 1/2" = **.21**
b. 5 7/8" = **.49**
c. 7 3/8" = **.61**
d. 8 3/4" = **.73**
e. 3 1/2" = **.29**
f. 33 3/4" = **2.81**
g. 27 1/4" = **2.27**
h. 75 1/2" = **6.29**
i. 4 1/4" = **35**
j. 3 5/8" = **.30**
k. 6 3/4" = **.56**
l. 9 1/2" = **.79**
m. 9 3/4" = **.81**
n. 7 1/4" = **.60**
o. 21 1/2" = **1.79**

Answer sheet for exercise 6: Convert these to feet, inches, and fractions:

a. 1.59 = **1'-7 1/8"**
b. 6.87 = **6'-10 1/2"**
c. 9.36 = **9'-4 3/8"**
d. .95 = **11 3/8"**
e. .22 = **2 5/8"**
f. 3.45 = **3'-5 3/8"**
g. 1.63 = **1'-7 5/8"**
h. 10.73 = **10'-8 3/4"**
i. 1.14 = **1'-1 3/4"**
j. 12.06 = **12'- 3/4"**
k. 11.91 = **11'-10 7/8"**
l. 4.41 = **4'-4 7/8"**
m. 9.69 = **9'-8 1/4"**
n. 1.24 = **1'-2 7/8"**
o. 1.71 = **1'-8 1/2"**

Answer sheet for exercise 7: Convert the following to U.S. Standard system:

a. 4.6 meters to feet = **15.09 feet**

b. 0.72 meters to inches = **28.35 inches**

c. 75 meters to yards = **82.05 yards**

d. 500 decimeters to feet = **164.05 feet**

e. 4000 millimeters to inches = **157.48 inches**

f. 38 kilometers to miles = **23.61 miles**

g. 2800 centimeters to feet = **91.87 feet**

h. 0.64 kilometers to yards = **700.16 yards**

Convert the following to the Metric System

a. 25 miles to kilometers = **40.23 kilometers**

b. 12.37 feet to meters = **3.77 meters**

c. 273/4" to decimeters = **7.04 decimeters**

d. 15 yards to meters = **13.72 meters**

e. 13,000 feet to kilometers = **3.96 kilometers**

f. 41/8" to centimeters = **10.36 centimeters**

Answer sheet for exercise 8: Calculate the length of the diagonals for the following squares. Express your answers in decimal feet.

1. 12' = **16.97'**
2. 76.58' = **108.28'**
3. 42'- 9" = **60.45'**
4. 38.26 meters = **177.50'**

Answer sheet for exercise 9: Calculate the length of the diagonals for the following rectangles. Express your answers in decimal feet.

1. 16' x 22' = **27.20'**
2. 38.52' x 46.49' = **60.37'**
3. 26'-8" x 37'-7 1/2" = **46.11'**
4. 12.7 meters x 16.48 meters = **68.26'**

UNIT X: CONSTRUCTION MATH

Measurement Systems

Working With Fractions

Figure 10-1 below shows the proper name for the two numbers in a fraction.

The numerator is the number on top and the denominator is the number on the bottom of the fraction.

To add or subtract fractions you must work with the same denominator, or in arithmetic terms "like fractions".

$$\frac{1}{2}\quad\begin{matrix}\text{Numerator}\\ \text{Denominator}\end{matrix}$$

Figure 10-1

If the fractions you are going to work with are already expressed as like fractions, then you can simply add or subtract the numerators and reduce the fraction to it's lowest term.

Figure 10-2 shows the addition of like fractions.

$$\frac{1}{8}+\frac{3}{8}=\frac{4}{8}=\frac{1}{2}$$

Figure 10-2

The addition of the numerators of 1 and 3 equals 4. When the fraction is expressed as $^4/_8$ both the numerator and the denominator are evenly divisible. This indicates that the fraction is not reduced to it's lowest term. Divide both by 4 and the reduced fraction is $^1/_2$.

To subtract like fractions use the same procedure. (Figure 10-3)

$$\frac{3}{8}-\frac{1}{8}=\frac{2}{8}=\frac{1}{4}$$

Figure 10-3

The subtraction of the numerators of 3 and 1 equals 2. When the fraction is expressed as $^2/_8$ both the numerator and the denominator are evenly divisible. This indicates that the fraction is not reduced to its lowest term. Divide both by 2 and the reduced fraction is $^1/_4$.

When the fractions are not expressed with the same denominator you must form like fractions. To form like fractions, multiply the larger fraction by whatever number is needed to form a common denominator.

In Figure 10-4 we are asked to add the fractions $^1/_2$ and $^1/_8$.

$$\frac{1}{2}+\frac{1}{8}=\frac{?}{?}$$

$$\frac{1}{2}\begin{matrix}\times\\ \times\end{matrix}\frac{4}{4}\begin{matrix}=\\ =\end{matrix}\frac{4}{8}$$

$$\frac{1}{8}+\frac{4}{8}=\frac{5}{8}$$

Figure 10-4

To form the common denominator we will multiply the larger fraction ($^1/_2$) by a number that will form a common denominator of 8 (which is 4).

Once we have formed the common denominator we can add as we did previously. Since the sum is not evenly divisible, this fraction is already expressed in the lowest term.

You can form a common denominator for any set of fractions, however, **you must multiply the numerator by the same number as the denominator**.

Subtraction of fractions can be worked using the same procedure.

Exercise 1: Add or subtract the following measurements.

a. $\frac{1}{8}'' + \frac{5}{8}'' =$

b. $\frac{1}{4}'' + \frac{3}{4}'' =$

c. $1\frac{5}{8}'' + 1\frac{1}{8}'' =$

d. $\frac{1}{2}'' + \frac{3}{8}'' =$

e. $\frac{3}{8}'' + \frac{3}{4}'' =$

f. $3\frac{3}{4}'' + 2\frac{1}{4}'' =$

g. $\frac{3}{4}'' - \frac{1}{4}'' =$

h. $\frac{5}{8}'' - \frac{3}{8}'' =$

i. $\frac{7}{8}'' - \frac{1}{4}'' =$

j. $1\frac{3}{4}'' - 1\frac{1}{8}'' =$

k. $2\frac{7}{8}'' - 1\frac{1}{2}'' =$

l. $3\frac{5}{16}'' - 1\frac{3}{4}'' =$

Working With Decimal Numbers

The rules for addition, subtraction, multiplication, and division of decimal numbers are reviewed in Figures 10-5 through 10-7.

For addition and subtraction, the decimal points must be lined up.

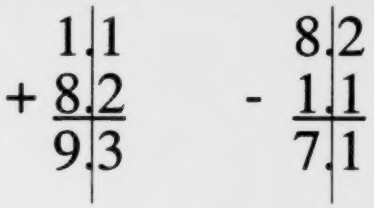


Figure 10-5

For multiplication, add the number of digits behind decimal points in the problem and move that number to the left in the answer.

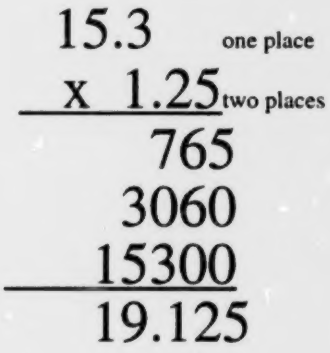
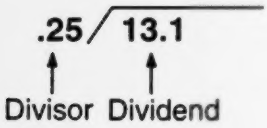


Figure 10-6

In division the number to be divided is called the "dividend" and the number that is doing the dividing is called the "divisor".

To divide with a decimal, move the decimal point to the right in the divisor to form a whole number (.25 becomes 25.0). Move the decimal point in the dividend (13.1) the same number of places and add zeros when needed(13.1 becomes 1310.0)

Divide as normal and line the decimal point straight up in the answer.



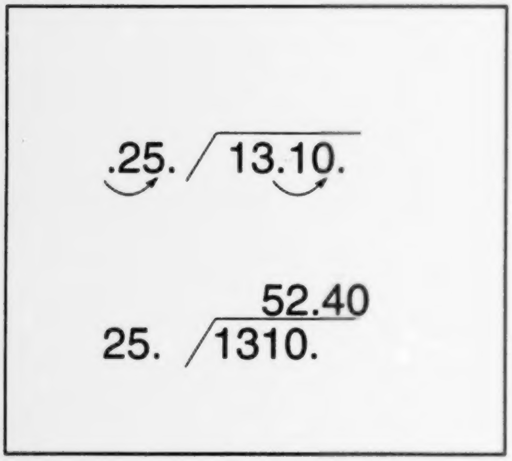


Figure 10-7

Exercise #2: Work the following problems without a calculator and round the answers to 3 decimal places.

Add the following figures. Be sure that the decimal point is in the correct place.

1. 5.66 + 20.75 + 16.03 =
2. 10.95 + 3.06 + 9.47 =
3. 3.958 + 24.976 + 21.954 =

Subtract the following:

1. 5.13 - 4.01 =
2. 12.28 - 6.67 =
3. 106.29 - 0.66 =

Multiply the following:

1. 5.16 x 1.5 =
2. 3.1 x .05 =
3. 1.3 x 2.51 =

Divide the following and place the decimal point in the proper place:

1. 505.5 ÷ 50. =
2. 50.9 ÷ 15. =
3. 56.7 ÷ 2.5 =

Exercise 3: Use a calculator to work the following multiplication and division problems; round your answer to 2 decimal places.

	Multiplication		Division
1.	1034.67 x 201 =	1.	5826 ÷ 6.5 =
2.	.51 x 21 =	2.	.25 ÷ .5 =
3.	1.21 x .09 =	3.	4.58 ÷ 1.5 =
4.	6.18 x 1.16 =	4.	100.13 ÷ .25 =
5.	635.5 x 1.01 =	5.	341.4 ÷ 2.7 =
6.	195.5 x 10.3 =	6.	.369 ÷ .80 =
7.	64.555 x .50 =	7.	5694.45 ÷ 54.4 =

TABLE 10-1: DECIMAL/INCH COMPARISON

U.S. STANDARD FOOT		DECIMAL FOOT
1"		= .08'
2"		= .17'
3"	1/4 FOOT	= .25'
4"	1/3 FOOT	= .33'
5"		= .42'
6"	1/2 FOOT	= .50'
7"		= .58'
8"	2/3 FOOT	= .67'
9"	3/4 FOOT	= .75'
10"		= .83'
11"		= .92'
12"	1 WHOLE	= 1.00'
1'-1"		= 1.08'

TABLE 10-2: U.S. STANDARD TO DECIMAL SYSTEM CONVERSION

FEET AND INCHES	TENTHS AND HUNDREDTHS
1/8"	0.01'
1/4"	0.02'
3/8"	0.03'
1/2"	0.04'
5/8"	0.05'
3/4"	0.06'
7/8"	0.07'
1"	0.08'
2"	0.17'
3"	0.25'
4"	0.33'
5"	0.42'
6"	0.50'
7"	0.58'
8"	0.67'
9"	0.75'
10"	0.83'
11"	0.92'
12"	1.00'
1'-3"	1.25'
1'-4"	1.33'
1'-6"	1.50'
1'-9"	1.75'

The six basic conversion parts to remember are:

1/8" .... = ... 0.01'
1" .... = ... 0.08'
3" .... = ... 0.25'
6" .... = ... 0.50'
9" .... = ... 0.75'
12" or 1 foot ... = ... 1.00'

Exercise 4: Use the conversion table on page 6 to convert the following U.S. Standard expressions to decimal expressions:

1. 1/8" =
2. 1" =
3. 5" =
4. 11" =
5. 7/8" =
6. 8" =
7. 1/2" =
8. 3" =
9. 3/8" =
10. 9" =
11. 6" =
12. 3/4" =
13. 12" =
14. 2" =
15. 1/4" =
16. 7" =
17. 10" =
18. 5/8" =
19. 4" =
20. 1'-3" =

Converting Between the U.S. Standard and the Decimal System

There are several ways to convert between measuring systems. One of the easiest methods to convert between the Decimal and U.S. Standard measuring systems is to form an equivalent ratio of 1/8" = 0.01'.

By forming this ratio you can change a fraction to eighths and express that same number of eighths as hundredths or vice versa.

The ratio of 1/8" = 0.01' is not exact. Due to rounding 1/8" actually equals 0.01333' · · · or one and a third hundredths. This rounding can be accounted for and will not cause an error until you start converting more than eight-eighths at one time.

To eliminate the rounding error, do not convert more than eight-eighths at one time. Instead convert the closest whole inch equivalent first, then change the remainder to eighths and convert that to hundredths. To complete the conversion, add the equivalent of the closest whole inch and the remainder together.

The examples that follow demonstrate this 2-step process:

Examples: Change the inches to a decimal of a foot then the fraction to decimal of a foot and add the two together.

a. 18 3/8" = ?
18" = 1.50'
3/8" = + .03'
1.53'

b. 11 5/8" = ?
11" = .92'
5/8" = + .05'
.97'

c. 2 3/4" = ?
2" = .17'
3/4" = + .06'
.23'

d. 16 1/4" = ?
16 = 1.33'
1/4" = + .02'
1.35'

Exercise 5: Convert the following to feet, tenths, and hundredths.

a. 2 1/2" =
b. 5 7/8" =
c. 7 3/8" =
d. 8 3/4" =
e. 3 1/2" =
f. 33 3/4" =
g. 27 1/4" =
h. 75 1/2" =
i. 4 1/4" =
j. 3 5/8" =
k. 6 3/4" =
l. 9 1/2" =
m. 9 3/4" =
n. 7 1/4" =
o. 21 1/2" =

Converting Between the Decimal and the U.S. Standard System

To convert from the decimal system to the U.S. Standard System use the same technique.

Subtract the largest whole inch increment from the expression, convert the remainder to eighths of an inch and reduce to the lowest terms (see examples below).

Examples: Subtract the closest whole inch increment from the decimal expression and convert the remainder to eighths (reduce to lowest terms if needed).

a.
4.28' = ?
- 4.25 = 4' - 3"
0.03 = 3/8 = + 3/8"
4' - 3 3/8"

b.
0.89' = ?
-0.83 = 0' - 10"
0.06 = 6/8 = + 3/4"
0' - 10 3/4"

c.
8.37 = ?
-8.33' = 8' - 4"
0.04 = 4/8" = + 1/2"
8' - 4 1/2"

d.
0.79 = ?
-0.75 = 9"
0.04 = 4/8" = + 1/2"
9" - 1/2"

Exercise 6: Convert these to feet, inches, and fractions:

a. 1.59 =
b. 6.87 =
c. 9.36 =
d. .95 =
e. .22 =
f. 3.45 =
g. 1.63 =
h. 10.73 =
i. 1.14 =
j. 12.06 =
k. 11.91 =
l. 4.41 =
m. 9.69 =
n. 1.24 =
o. 1.71 =

The Metric System

The metric system is a base ten system similar to the decimal system we have been working with.

However, the metric system uses the meter rather than the foot as a basic unit of length measure.

Each meter consists of 10 decimeters and each decimeter consists of 10 centimeters. This same relationship of one unit consisting of ten other units is true throughout the metric system, in fact, we could continue with the breakdown to the billionth if we needed to.

Table 2-3 illustrates the prefix naming convention used for each unit of 10 in the metric system.

Conversions between the metric and U.S. Standard system are possible using a variety of different methods. One of the easiest is using what is called a multiplier. The multiplier is used exactly as its name suggests, you simply multiply whatever you need to convert by the appropriate factor. For example, if we needed the distance of 23.75 meters converted to feet, we would multiply 23.75 x 3.281 (from Table 10-4) and get 77.92 feet.

Table 10-4
Metric / U.S. Standard Multipliers

To Convert From	To	Multiply By:
Meters	Inches	39.37
Meters	Feet	3.281
Meters	Yards	1.094
Kilometers	Miles	0.6214
Inches	Meters	0.0254
Feet	Meters	0.3048
Yards	Meters	0.9144

Table 10-3: Metric Prefixes

Multiplication Factors				Prefix	Symbol
	1,000,000,000,000	=	10^{12} [a]	tera	T
	1,000,000,000	=	10^{9} [b]	giga	G
	1,000,000	=	10^{6}	mega	M
	1,000	=	10^{3}	kilo	K
	100	=	10^{2}	hecto	h
	10	=	10^{1}	deka	da
1 Meter					
	0.1	=	10^{-1}	deci	d
	0.01	=	10^{-2}	centi	c
	0.001	=	10^{-3}	milli	m
	0.000 000 1	=	10^{-6}	micro	μ
	0.000 000 000 1	=	10^{-9}	nano	n
	0.000 000 000 000 1	=	10^{-12}	pico	p

Table 10-4 shows some of the multipliers used to convert length measurements from and to the metric system.

Conversions for other standards of measure are possible with the use of a multiplier also. Appendix A in this manual contains a list of multipliers for various other conversion factors.

Exercise 7: Convert the following to U.S. Standard system:

a. 4.6 meters to feet =

b. 0.72 meters to inches =

c. 75 meters to yards =

d. 500 decimeters to feet =

e. 4000 millimeters to inches =

f. 38 kilometers to miles =

g. 2800 centimeters to feet =

h. 0.64 kilometers to yards =

Convert the following to the Metric System

a. 25 miles to kilometers =

b. 12.37 feet to meters =

c. $27^{3}/_{4}$" to decimeters =

d. 15 yards to meters =

e. 13,000 feet to kilometers =

f. $4^{1}/_{8}$" to centimeters =

Squaring Principles

Diagonal Length For A Square

The illustration below depicts a square 20 foot by 20 foot. The formula shows that to calculate a diagonal you can multiply a side length by 1.414.

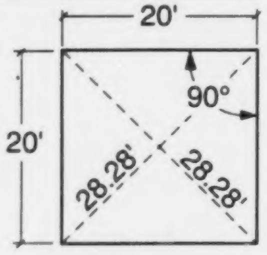


Figure 10-8

Formula: Diagonal = side length x 1.414

Example: Square is 20' x 20'
diagonal = 20' x 1.414
diagonal = 28.28

Diagonal Length For A Rectangle

The illustration below depicts a rectangle 27 foot by 65 foot. The formula shows that you can add the squares of each side together and the square root of that sum will be the length of a diagonal.

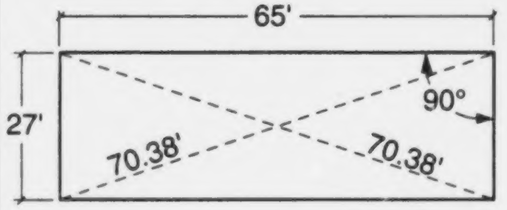


Figure 10-9

Formula: $a^2 + b^2 = c^2$
Diagonal: $= c$

Where: **a = width of the rectangle**
b = length of the rectangle
c = length of the diagonal
= square root symbol

Example: Rectangle is 27' x 65'

diagonal = (27' x 27')+(65' x 65')
diagonal = (729 + 4225)
diagonal = 4954
diagonal = 70.38'

Exercise 8: Calculate the length of the diagonals for the following squares. Express your answers in decimal feet.

1. 12' =

2. 76.58' =

3. 42'- 9" =

4. 38.26 meters =

Exercise 9: Calculate the length of the diagonals for the following rectangles. Express your answers in decimal feet.

1. 16' x 22' =

2. 38.52' x 46.49' =

3. 26'-8" x 37'-7 1/2" =

4. 12.7 meters x 16.48 meters =

Basic Survey Procedures

Measuring Protocols

Construction survey procedures are based on horizontal and vertical measurements. In order to maintain accuracy when working with survey stakes, the same protocols must be followed.

This means that whenever measurements are made from survey stakes the following procedures must be followed:

1. All length measurements should be made with the tape or chain held tight and level. If the length is to be measured on a slope or over an obstruction, the distance must be transferred vertically to the ground using an object to plumb with (such as a plumb bob).
2. All vertical measurements must be conducted with the grade rod or rule held plumb without bow or sag, and measured up or down from a level line.

Figure 10-10 shows the process of measuring a length on a slope. Note the use of a series of horizontal "jumps" to establish the true horizontal distance.

Vertical measurements can be conducted using the same "stair step" or "jump" routine. Figure 10-11 shows the process of measuring the vertical difference between the two stakes. Note that the vertical distances on each jump are measured from a level line and the measuring rod or rule is held plumb.

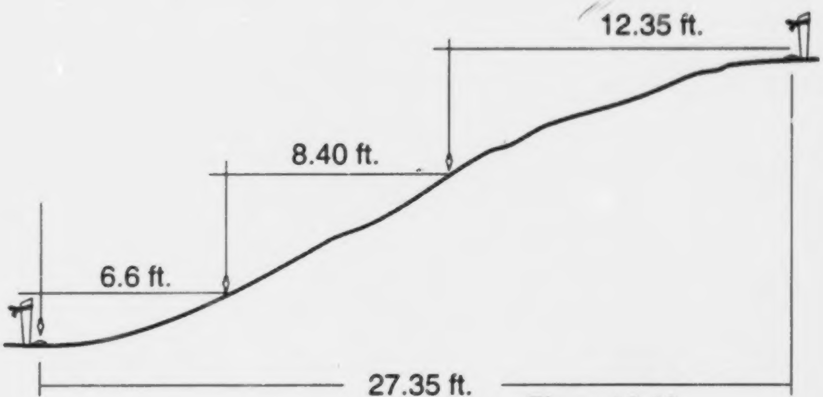


Figure 10-10

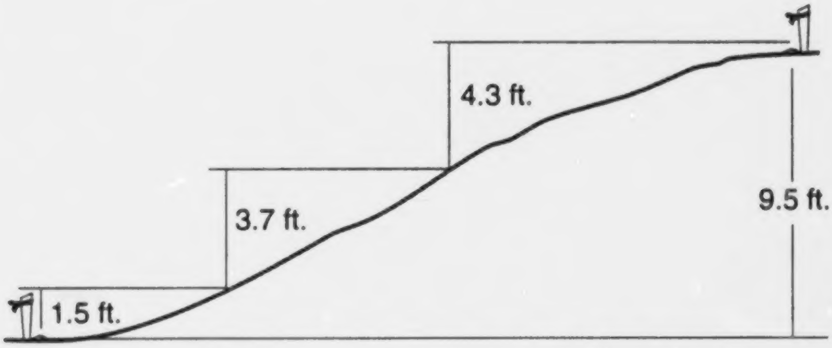


Figure 10-11

Principles of Differential Leveling

The term "differential leveling" refers to the process of establishing a difference of elevation between two or more points. The process can be used to determine the elevation of a unknown point by adding or subtracting the elevation difference from a known elevation.

For example, in Figure 10-12 stake 1 is at a known elevation of 105.00 feet Above Sea Level (ASL). If we subtract the elevation difference between stake 1 and stake 2 we can determine the ASL elevation of stake 2.

In order to determine the elevation difference between stake 1 and 2 in the illustration above, we may need to establish the elevation difference between stake 1 and our leveling equipment. For example, in Figure 10-13 below, we have to set up the level above stake 1.

The distance that we set up above stake 1 will be added to stake 1 to form what is called an HI. HI is the abbreviation for the term "Height of Instrument". Once we have determined the HI we can subtract the actual elevation difference between our HI and stake 2 to determine its elevation.

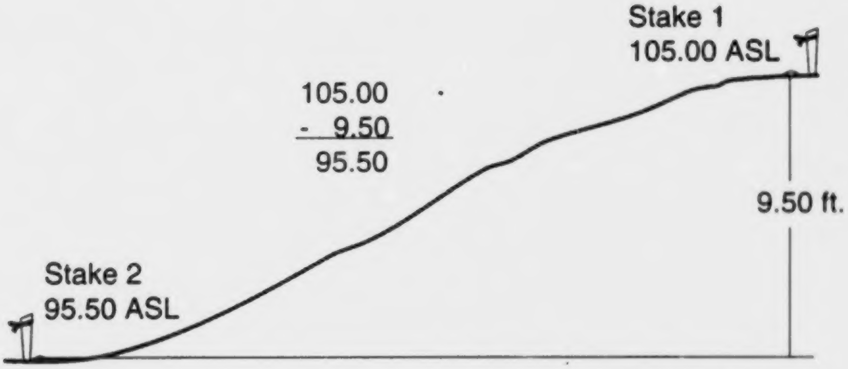

Stake 1
105.00 ASL
105.00
- 9.50
95.50
9.50 ft.
Stake 2
95.50 ASL

Figure 10-12

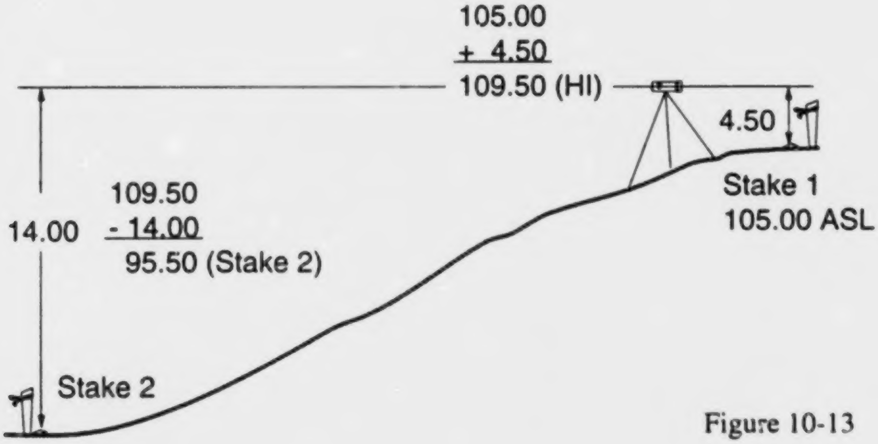

105.00
+ 4.50
109.50 (HI)
4.50
Stake 1
105.00 ASL
14.00
109.50
- 14.00
95.50 (Stake 2)
Stake 2

Figure 10-13

CONVERSION TABLES

TO CONVERT FROM	TO	MULTIPLY BY
Expressions of Area		
Acres	Square feet	43.560.0
Acres	Square yards	4.840.0
Acres	Square meters	4.047.0
Square inches	Square centimeters	6.452
Square feet	Square inches	144.0
Square feet	Square yards	0.1111
Square feet	Acres	2.296×10^{-5}
Square feet	Square meters	0.09290
Square yards	Square feet	9.0
Square yards	Square meters	0.8361
Square miles	Square kilometers	2.590
Square miles	Acres	640.0
Square millimeters	Square inches	0.01550
Square centimeters	Square inches	0.1550
Square meters	Square feet	10.764
Square meters	Square yards	1.1960
Square meters	Acres	2.471×10^{-4}
Square kilometers	Square feet	1.076×10^{7}
Square kilometers	Square miles	0.3861
Square kilometers	Acres	247.1
Expressions of Arc		
Minutes of angle	Seconds of angle	60.0
Minutes of angle	Degrees	0.01667
Linear Expressions		
Feet	Meters	0.3048
Yards	Centimeters	91.44
Yards	Meters	.9144
Millimeters	Inches	0.03937
Centimeters	Inches	0.3937
Meters	Inches	39.37
Meters	Feet	3.281
Meters	Yards	1.094
Kilometers	Feet	3281.0
Kilometers	Yards	1094.0
Kilometers	Miles	0.6214

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CONVERSION TABLES continued

TO CONVERT FROM	TO	MULTIPLY BY
Expressions for Liquid Volume		
Gallons	Cubic inches	231.0
Gallons	Liters	3.785
Cubic inches	Liters	0.016387
Cubic feet	Liters	28.32
Cubic feet	Gallons	7.481
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.2642
Liters	Cubic inches	61.02
Liters	Cubic centimeters	1000.0
Cubic meters	Gallons	264.2
Cubic meters	Liters	1000.0
Expressions of Velocity		
Feet per minute	Miles per hour	0.01136
Miles per hour	Feet per minute	88.0
Kilometers per hour	Feet per minute	54.68
Volume Expressions		
Cubic inches	Cubic centimeters	16.387
Cubic feet	Cubic inches	1728.0
Cubic feet	Cubic yards	0.03704
Cubic feet	Cubic meters	0.02832
Cubic yards	Cubic feet	27.0
Cubic yards	Cubic meters	0.7639
Cubic centimeters	Cubic inches	0.06102
Cubic meters	Cubic feet	35.31
Cubic meters	Cubic yards	1.308
Expressions of Weight		
Gallons	Pounds of water @ 68° F	8.346
Tons (short)	Pounds	2000.0
Tons (short)	Kilograms	907.2
Tons (long)	Pounds	2240.0
Tons (long)	Kilograms	1016.0
Tons (metric)	Pounds	2205.0
Tons (metric)	Kilograms	1000.0
Kilograms	Pounds	2.205

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METRIC EQUIVALENTS OF U. S. STANDARD VALUES

1 inch = 25.40 millimeters

1 inch = 2.54 centimeters

1 inch = 0.3048 meter

1 yard = 0.9144 meter

1 mile = 1.6093 kilometer

1 square inch = 6.452 square centimeters

1 square foot = 929.0 square centimeters

1 square yard = 0.8361 square meter

U.S. STANDARD EQUIVALENTS OF METRIC VALUES

1 millimeter = 0.03937 inch

1 millimeter = 0.003281 foot

1 centimeter = 0.3937 inch

1 meter = 39.37 inches

1 kilometer = 0.6214 mile

1 square centimeter = 0.1550 square inch

1 square meter = 1.1960 square yards

1 square meter = 10.764 square feet

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METRIC PREFIXES

MULTIPLICATION FACTORS		PREFIX	SYMBOL
1.000.000.000.000	$=10^{12}$ [a]	tera	T
1.000.000.000	$=10^{9}$ [b]	giga	G
1.000.000	$=10^{6}$	mega	M
1.000	$=10^{3}$	kilo	K
100	$=10^{2}$	hecto	h
10	$= 10^{1}$	deka	da
0.1	$= 10^{-1}$	deci	d
0.01	$= 10^{-2}$	centi	c
0.001	$= 10^{-3}$	milli	m
0.000 000 1	$= 10^{-6}$	micro	µ
0.000 000 000 1	$= 10^{-9}$	nano	n
0.000 000 000 000 1	$= 10^{-12}$	pico	p

(a = 1 trillion)
(b = 1 billion)

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REVIEW QUIZ

GENERAL CONSTRUCTION - SECTION 1, 2 & 3

1. Name 4 major types of construction?

utilities

building

highway

environmental

2. Construction Laborers are "all brawn and no brain." True or False?

a. True

[✓ b. **False**]

3. How many jobs are predicted in new construction growth by the Bureau of Labor Statistics, in the next decade?

a. none

b. quarter million

[✓ c. **about one million**]

d. about three million

e. about ten million

4. What 6 year government initiative will provide $119.5 billion for highway and bridge construction?

a. Environmental Protection Agency

[✓ b. **Intermodal Surface Transportation Efficiency Act of 1991**]

c. Federal Highway Fund

d. Superfund Amendments and Reauthorization Act

5. How many hazardous waste sites have been identified by the EPA?

a. less than 1200

[✓ b. **more than 1200**]

c. less than 120

d. more than 120

6. Fill in the blank for the chain of command for a contractor:

Project Manager

Project Superintendant

General Foreman

Labor Foreman

7. What are the 3 roles of the employer and employee in the construction industry? Fill in the blank.

Skill

Integrity

Responsibility

8. How much more per week does a union construction worker earn compared to their non-union counterparts?

a. more than $122 per day

[✓ b.] **more than $122 per week**

c. more than $122 per month

d. more than $122 per year

9. Which statement is false?

[✓ a.] **union benefits packages averaged nearly 90% less than benefits that non-union employers provided**

b. male union members averaged $95 a week more than their non-union counterparts

c. union women earned $119 more than non-union women

d. unionized African-American workers earned $147 a week more than in non-union

e. unionized Hispanic workers surpassed their non-union counterparts by $144 per week

10. What was the average base wage for unionized laborers across North America in 1992?

a. $9.20 per hour

[✓ b.] **$14.55 per hour**

c. $18.91 per hour

d. $20.91 per hour

11. How many more hours a year do trained workers work compared to untrained workers?

- a. 100 hours
- b. 200 hours
- c. 300 hours
- [✓ **d. 400 hours**]
- e. same number of hours

12. What has been the end result of the Taft-Hartley Act?

- a. "right to work" states earn $3,067 less than in bargaining states
- b. sales tax in "right to work" states are 60.3% compared to 43.8% in the bargaining states
- c. only 14% of "right to work" states are at or below the national job fatality rate compared to 67% for bargaining states
- d. only 10% of "right to work" states spend as much or more than the education cost per pupil compared to 57% of bargaining states
- [✓ **e. all of the above have been a result of the Taft-Hartley Act**]

13. Which statement is false as far as OSHA reform legislation is concerned?

- [✓ **a. joint health and safety committees are not allowed in any situation**]
- b. employers are required to provide safety and health training
- c. workers have the right to refuse unsafe work

14. What is the active membership of the Laborers International Union of North America?

- a. about 150,000
- b. less than 250,000
- c. less than 500,000
- [✓ **d. more than 500,000**]

What happened when Laborers-AGC first began training in the 1960's, using government subsidies, and the subsidies ran out?

a. no more training took place

b. the government never funded for training ever again

[✓ c.] **negotiated hourly contributions were created along with the creation of Laborers-AGC**

d. the government asked for the money back

16. Which agency rated the Hazardous Waste Worker Training Program the best in the country?

a. EPA

b. LIUNA

c. OSHA

d. IRA

[✓ e.] **NIEHS (National Institute of Environmental Health Sciences)**

17. How much larger in diameter does the striking face on a hammer have to be in comparison to a struck tool?

a. 1/4 inch

[✓ b.] **3/8 inch**

c. 1/2 inch

d. 5/8 inch

18. Name the 3 types of sockets?

Hand

Power

Impact

19. When you see "10-32" written on a hacksaw blade, what does each number indicate?

10 = length of blade

32 = teeth per inch

20. Name 3 common ratchet drive sizes?

3/8"

1/2"

3/4"

21. How could you tell the difference between a hand socket and an impact socket?

Impact sockets have heavy walls

Impact sockets are usually flat black

Impact sockets have an o-ring and pin

22. Name 4 different file shapes?

Round

Half round

Flat

Three square (triangular)

23. What is the purpose of a bung wrench?

A bung wrench will open a drum safely and efficiently

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REVIEW ANSWERS

GENERAL CONSTRUCTION - SECTION 1, 2 & 3

1. utilities
building
highway
environmental

2. b

3. c

4. b

5. b

6. project superintendant

7. responsibility

8. b

9. a

10. b

11. d

12. e

13. a

14. d

15. c

16. e (National Institute of Environmental Health Sciences)

17. b

18. hand
power
impact

19. 10 = length of blade
32 = teeth per inch

20. 3/8"
1/2"
3/4"

21. impact sockets have heavy walls
impact sockets are usually flat black
impact sockets have an o-ring and pin

22. round
half round
flat
three square (triangular)

23. A bung wrench will open a drum safely and efficiently

REVIEW QUIZ

GENERAL CONSTRUCTION - SECTION 4

1. According to OSHA, what is the definition of a confined space? Fill in the blanks.

   Any space having a limited means of **egress** which is subject to the accumulation of **toxic** or **flammable** contaminants or has an **oxygen** deficient environment.

2. How often should garbage and other waste be disposed? Fill in the blanks.

   Should be disposed of at **regular** and **frequent** intervals.

3. A first aid kit shall have supplies in individually sealed packages inside a waterproof container. How often should these contents be checked by the employer?

   a. before the start of each job and at least daily

   [✓ b.] **before the start of each job and at least weekly**

   c. before the start of each job and at least monthly

   d. before the start of each job and at least twice a year

4. What type of toilet facilities should be provided on a work site with 20 or less employees?

   [✓ a.] **one toilet**

   b. two toilets

   c. one toilet and one urinal

   d. one toilet and two urinals

5. How many decibels can you be exposed to in 15 minutes, per day?

   a. 90

   b. 97

   c. 105

   [✓ d.] **115**

6. The gases, vapors, fumes, dusts and mists standard does not include which of the following?

a. airborne asbestos

b. tremolite

c. anthophyllite

d. actinolite

[✓ e.] **all of the above**

7. When disposing gases, vapors, fumes, dusts and mists using a ventilation or exhaust system, where should they be discharged?

a. to an adjacent room or compartment

b. to the next country

c. into a special holding tank

[✓ d.] **to the outside atmosphere**

8. What is the recommended eye protection when acetylene cutting?

a. goggles, spectacles

b. spectacles, chipping goggles

c. goggles, face shield, welding helmet

[✓ d.] **welding goggles**

9. What should you do if any lifeline, lanyard, or safety belt has been subjected to in service loading? (A fall has ocurred while the fall equipment was being worn)

[✓ a.] **removed from service and never used again**

b. inspected and reused

c. inspected by a site safety inspector and used again only on their recommendation

d. there is no need for retesting because fall arrest equipment can withstand up to 4,000 pounds of force at any time

10. What is the maximum travel distance from any point of a protected area to the nearest fire extinguisher?

    a. not to exceed 10 feet

    [✓ b.] **not to exceed 100 feet**

    c. not to exceed 1000 feet

    d. must be available on the same work site

11. How many fire extinguishers rated not less than 2A, have to be available on a multistory building?

    a. 10

    b. 1 every 4th floor

    c. 1 every 3rd floor

    d. 1 every 2nd floor

    [✓ e.] **1 every floor**

12. When an approved metal cabinet is used to store flammable or combustible materials, how should it be labelled?

    a. "Dangerous, explosive materials"

    b. "Do not enter without authorization"

    c. "Flammable-Keep Away"

    [✓ d.] **"Flammable-Keep Fire Away"**

13. What is the color of the flagmens' vest?

    a. red or white

    b. purple or pink

    [✓ c.] **red or orange**

    d. green or white

14. How high can masonry blocks be stacked before you must begin to taper them back one half block per tier?

[✓ a.] **6 ft** c. 8 ft

b. 7 ft d. 9 ft

15. Complete this statement. Materials cannot be stored within __________ of a floor opening inside a building under construction.

a. 2 ft

b. 3 ft

c. 4 ft

d. 5 ft

[✓ e.] **6 ft**

16. How often is rigging material to be inspected?

a. before the job begins and weekly thereafter

b. every second day

c. rigging material never has to be inspected

[✓ d.] **prior to use on each shift and as necessary**

17. What is the proper way to install a u-bolt on an eye splice?

[✓ a.] **u-bolt on the dead end**

b. u-bolt on the live end

c. saddle on the dead end

d. knot over the eye splice

18. Complete the statement. The use of ____________________ ____________________ for hoisting or lowering tools shall not be permitted.

a. hoisting buckets c. experienced signallers

b. trained operators [✓ d.] **electric cords**

19. Which of the following statements about powder actuated tools is false?

   a. only workers who are trained in that particular tool are allowed to operate it

   [✓ b.] **loaded tools cannot be left unattended for any longer than 5 minute intervals**

   c. the tool shall be tested each day before loading

   d. a tool that is loaded or empty cannot be pointed at anyone

   e. no fastener can be driven into a spalled area

20. Which of the following rigging statements is true?

   a. cylinders can be hoisted unsecured on a cradle, slingboard or pallet

   b. cylinders should be moved by rolling them on their sides

   [✓ c.] **valve protection caps cannot be used for lifting cylinders from one vertical position to another**

   d. regulators must be removed and valve protection caps must be put into place before cylinders are moved in a special carrier

   e. damaged or defective cylinders can be used only in special situations

21. Worn or frayed cords can be used in special situations. For example, when only one concrete vibrator cord is available during a placing job. True or false?

   a. True [✓ b.] **False**

22. Each employer must provide a ladder training program for employees as necessary. True or false?

   [✓ a.] **True** b. False

23. Which of the following would be classified as a class B fire?

   a. wood, cloth, paper, rubber, and most plastics

   [✓ b.] **flammable liquids and gases, oil, grease, tar, and paint**

   c. electrical equipment

   d. combustible metal

24. What is the maximum discharge time for a cartridge type, dry chemical fire extinguisher?

a. 10 seconds

b. 15 seconds

c. 20 seconds

[✓ d. **25 seconds**]

25. List 5 inspection procedures for a portable fire extinguisher:

Operating instructions can be read

Seals are not broken or missing

Weigh or heft to determine if full

Examine for damage (rust, leaks, clogged nozzles)

Pressure gauge reading is in operating zone

26. Maintenance on a portable fire extinguisher can only be carried out by qualified service personnel. True of false?

[✓ a. **True**]

b. False

27. List 5 things you should know about dry chemicals used in portable fire extinguishers:

Never mix different chemicals

Fire extinguisher chemicals are considered non-toxic

Do not store over 140 F

Do not use dry chemicals on electrical contacts

Dry chemicals will not put out fire in other chemicals that produce oxygen

REVIEW ANSWERS

GENERAL CONSTRUCTION - SECTION 4

1. Regulation 1926.21(6)ii

   egress
   toxic
   flammable
   oxygen

2. Regulation 1926.25(c)

   regular
   frequent

3. Regulation 1926.50(d)(2)

   b

4. Regulation 1926.51 Table D-1

   a

5. Regulation 1926.52 Table D-2

   d

6. Regulation 1926.55(c)

   e

7. Regulation 1926.57(e)

   d

8. Regulation 1926.102 Table D-2

   d

9. Regulation 1926.104(a)

   a

10. Regulation 1926.150(c)(i)

    b

11. Regulation 1926.150(c)(iv)

    e

12. Regulation 1926.152(iii)

    d

13. Regulation 1926.201(a)(iv)

    c

14. Regulation1926.250(b)(vii)

    a

15. Regulation 1926.250(4)(b)

    e

16. Regulation 1926.251(a)(i)

    d

17. Regulation 1926.251(5)(i)

    a

18. Regulation 1926.302(a)(2)

    d

19. Regulation 1926.302(a)(2)

    b

20. Regulation 1926.350(a)(6)

    c

21. Regulation 1926.416(e)(i)

    b (false)

22. Regulation 1926.1060(a)

    a (True)

23. b

24. d

25. Operating instructions can be read

    Seals are not broken or missing

    Weigh or heft to determine if full

    Examine for damage (rust, leaks, clogged nozzles

    Pressure guage reading is in operating zone

26. a (True)

27. Never mix different chemicals

    Fire extinguisher chemicals are considered non-toxic

    Do not store over 140 F

    Do not use dry chemicals on electrical contacts

    Dry chemicals will not put out fire in chemicals that will produce oxygen

REVIEW QUIZ

GENERAL CONSTRUCTION - SECTION 5

1. List each of the strokes in 4 cycle and 2 cycle gasoline engines in order of occurrence?

   Intake

   Compression

   Power

   Exhaust

2. How many ounces of 2 cycle oil would you add to 5 gallons of gasoline to obtain a 32:1 ratio?

   a. 8

   b. 12

   c. 16

   [✓ **d. 20**]

   e. 24

3. What weight of oil should be used in the crankcase of a small engine?

   a. 5W 30

   [✓ **b. 30**]

   c. 10W 30

   d. 20W 50

4. When troubleshooting an engine that will not start, list 4 items that you should check?

   Ignition switch is on

   Fuel (age and amount)

   Compression

   Spark plug (physical condition and spark quality)

5. Name the 2 common types of water pumps used on construction sites?

Centrifugal

Diaphragm

6. What procedures should be followed at the end of the day when you are using a pump in below freezing weather?

   a. remove drain plug

   b. flush out any remaining solids

   c. run the pump for about 15 seconds with the drain plug out to assure all water is removed

   [✓ d.] **all of the above**

7. List 3 ways you can prevent kickback from occurring when using a chain saw?

Cut with a sharp chain / Cut at full throttle / Use proper depth gauge

ht / Never cut in the danger zone on the bar tip / Do not let the saw bind /

Take extra care when trimming bushy trees / Grip saw securely / Don't operate when tired

8. List 4 safety features on a chain saw?

Chain brake / Front hand guard / Rubber mounts / Rear hand guard

/ Anti-kickback chain / Chain catcher / Muffler / Dog (spiking bucks)

/ Carrying case (protective sleeve)

9. The blade on an all purpose saw should not match or exceed the maximum operating speed of the saw? True or false?

   a. True

   [✓ b.] **False**

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10. What throttle speed should you use when cutting with a chain saw or all purpose saw?

a. 1/8 speed

b. 1/4 speed

c. 1/2 speed

d. 3/4 speed

[✓ e.] **full throttle**

11. How often should the air filter of an all purpose saw be checked when cutting in dusty conditions?

a. once a day

b. twice a day

c. every hour

[✓ d.] **every half hour**

e. when the filter is clogged

12. What is the function of a GFI?

a. increases the voltage to the electric tool

b. detects the amount of current going through the electric cord

[✓ c.] **detects current leakage and quickly shuts off the power supply**

d. leads mercenary missions to the deep jungles of South America

13. Every electric tool must have a three prong plug. True or false?

a. True

[✓ b.] **False**

14. Name 3 things that should be considered before selecting a cord for an electric tool?

tool amperage

length of cord

power cord gauge

15. Complete the following statement. Many newer compressors will not start if the compressor is more than ____________ off level.

   a. 3 - 6 degrees

   b. 9 - 11 degrees

   c. 11 - 13 degrees

   [✓ d.] **17 - 20 degrees**

16. Why is it important to check the pop off valve on a compressor?

   Prevents air tank from becoming overpressurized and blowing up

   ____

17. What is the pre-set air pressure in an air compressor?

   a. 60 - 80

   [✓ b.] **80 - 100**

   c. 100 - 120

   d. 120 - 140

18. What should you do with the 90-pound pavement breaker when it is not pushing against the work?

   a. turn the trigger on

   [✓ b.] **turn the trigger off**

   c. operate the breaker at 1/2 throttle

   d. operate the breaker at 3/4 throttle

19. What size of bits fit inside the 60 and 90 pound pavement breaker?

   [✓ a.] **1-1/8" & 1-1/4"**

   b. 1" & 1-1/2"

   c. 1-1/8" & 1-1/2

   d. 1-1/16 & 1-1/4

20. Name the 6 lowest powder load strengths by number and color?

1 - gray

2 - brown

3 - green

4 - yellow

5 - red

6 - purple

21. Hilti powder actuated tool fasteners are driven into which 2 kinds of material?

concrete

steel

22. How far away from a concrete edge should a Hilti fastening be made?

a. 1"

[✓ **b. 2"**]

c. 3"

d. 4"

23. How far away from a steel edge should a Hili fastening be made?

a. 1/4"

[✓ **b. 1/2"**]

c. 3/4"

d. 7/8"

REVIEW ANSWERS

GENERAL CONSTRUCTION - SECTION 5

1. Intake
   Compression
   Power
   Exhaust

2. d

3. b
4. Ignition switch on
   Fuel (age and amount)
   Compression
   Spark plug (physical condition and spark quality)

5. Centrifugal
   Diaphragm

6. d

7. Cut with a sharp chain
   Cut at full throttle
   Use proper depth gauge height
   Never cut in the danger zone on the bar tip
   Do not let the saw bind
   Take extra care when trimming bushy trees
   Grip the saw securely
   Do not operate the saw when tired

8. Chain brake
   Front hand guard
   Rubber mounts
   Rear hand guard
   Anti-kickback chain
   Chain catcher
   Muffler
   Dogs/bucking spikes
   Carrying case/protective sleeve

9. b (False)

10. e

11. d

REVIEW ANSWERS (cont'd)

GENERAL CONSTRUCTION - SECTION 5

12. c

13. b (False)

14. Tool amperage
    Length of cord
    Power cord gauge

15. d

16. Prevents air tankfrom becoming overpressured and blowing up

17. b

18. b

19. a

20. 1 - gray
    2 - brown
    3 - green
    4 - yellow
    5 - red
    6 - purple

21. concrete
    steel

22. b

23. b

13. Name 3 important things you should know before you make a lift?

Capicity of equipment

Wt. of load

Safe working load of rigging hardware

14. How many wires per strand are found in a 6x19, 1/2" wire rope?

a. 6

[✓ b.] **19**

c. 25

d. 13

15. When a wire rope is threaded through a wedge and socket, how far should the dead end stick out of the socket?

a. 5 - 8"

[✓ b.] **6 - 9"**

c. 7 - 10"

d. 8 - 11"

16. How far apart are cable clips placed when installing them around a thimble on a 1/2" wire rope?

a. 1"

b. 2"

[✓ c.] **3"**

d. 4"

17. How many foot - pounds should the nuts be tightened on a u - bolt attached to a 1/2" wire rope?

a. 55 ft - lbs

[✓ b.] **65 ft - lbs**

c. 75 ft - lbs

d. 85 ft - lbs

18. As the sling angle from the horizontal increases, (actual angle becomes smaller) the lifting capacity __________?

[✓ a.] **increases**

b. decreases

c. stays the same

19. The i.d tag on a 5/8" wire rope is missing and no chart is available to tell you the S.W.L.. Using the formula you learned, what is the S.W.L. of the wire rope?

S.W.L. = wire rope diameter x wire rope diameter x 8

S.W.L. = 5/8 x 5/8 x 8

S.W.L. = 3.125 Tons

20. What is the formula for a safe working load on a three leg bridle hitch?

S.W.L. = S.W.L (single vertical hitch) x H/2 x 2

21. According to the following information, what is the total S.W.L. for a 4 leg bridle hitch?

- You will be using 1/2" wire rope slings to make the lift. (S.W.L. of one vertical leg is unknown)
- Height from hook to load is 8 feet.
- Length of sling from load to hook is 9 feet.

Use the following formulas:

1) S.W. L. (1 leg) = 1/2 x 1/2 x 8

2) TOTAL S.W.L. = S.W.L. (1 leg) x H/L x 2

S.W.L. = 1/2 x 1/2 x 8

S.W.L. = 2 Tons

S.W.L. = S.W.L. (1 leg) x H/L x 2

S.W.L. = 2 x 8/9 x 2

S.W.L. = 3.55 Tons

22. List four things that influence the process of soil compaction:

Moisture content

Soil type

Ht. of lift

Method of compaction

23. When compacting soil you are concerned with three types of soil. Name these soil types:

Cohesive

Partly cohesive

Granular

24. What two things happen when soil is compacted?

Soil particles move closer together

Air is forced out

25. Which compactor would work best when compacting clay soils?

a. vibrating plate compactor

b. vibrating roller compactor

[✓ c.] **rammer compactor (wacker)**

d. non-vibrating roller compactor

26. The right amount of moisture in the soil acts as a ____________ on the soil particles.

a. pump

b. filler

[✓ c.] **lubricant**

d. guide

27. In order to get the best compaction while backfilling, what should be the height of each lift ?

a. 12" - 18"

b. 9" - 15"

c. 4" - 16"

[✓ d.] 6" - 12"

28. When preparing a work area for oxy-fuel cutting operations, what are three safety precautions that should be taken?

Fire proof floor / Fire proof table

Ventilation / Flash shield

Cylinders are chained

29. List five safety precautions for fire protection during oxy-fuel cutting operations.

Check equipment for oil, grease or damage

Keep flames and sparks away from hoses

Remove all combusttibles from the work area

Keep fire extinguisher at hand

Never test gas leaks with a flame

30. Oxygen should never be used:

a. to blow out pipelines

b. to start gasoline engines

c. to dust off equipment or work area

d. for ventilation

[✓ e.] for all of the above

31. A common pressure setting for oxy-fuel cutting for metals from 1/4" to 1/2" thick would be:

   a. 17 psi on fuel gauge and 35 psi on oxygen gauge

   b. 8 psi on fuel gauge and 60 psi on oxygen gauge

   [✓ c.] **13 psi on fuel gauge and 45-50 psi on oxygen gauge**

   d. 6 psi on fuel gauge and 25 psi on oxygen gauge

32. As fuel and oxygen flow through the regulators and hoses, they are mixed when they reach ____________________ :

   a. The torch handle

   b. The torch head

   [✓ c.] **The lower tube on the cutting attachment**

   d. The cutting attachment head

33. When selecting a torch tip for cutting different thickness metals, which tip would be used for cutting 1/2" metal.

   a. No. 4

   b. No. 2

   [✓ c.] **No. 0**

   d. No. 000

Laborers-AGC Education and Training Fund

COURSE

OVERVIEWS

Laborers-AGC Education and
Training Fund
PO Box 37
Pomfret Center, CT 06259

LIUNA
INNOVATION
AT WORK

CONSTRUCTION SKILLS COURSES

CRAFT ORIENTATION

The 4-hour **Craft Orientation** course introduces students to the wide range of jobs that are available in the building, heavy and highway, utility, and environmental construction field. Job descriptions are presented to help new laborers choose a career path. This course covers the following topics:

- **The Construction Industry**

  Students learn about the Construction Industry and how it operates. The responsibilities of the employer and employee are discussed, as well as the normal chain of command.

- **Wages and Benefits**

  Students are provided with wage and benefit information. Wage laws are discussed, as well as the benefits of working for union employers.

- **OSHA**

  Students are provided with information on the major provisions of OSHA legislation.

- **LIUNA Organizations**

  Students are provided with a brief historical explanation of LIUNA and its affiliated organizations. Also, information is presented on other organizations, including LECET, LHSFNA, and the Laborers-AGC Education and Training Fund.

- **Employer Organizations**

  Students are provided with information on the employer organizations, such as the AGC.

CONSTRUCTION ENGLISH AS A SECOND LANGUAGE

The 80-hour **Construction English as a Second Language** course is designed for the students whose first language is not English. Students learn how to prepare for and successfully complete construction skills training. This course includes:

- **Questions**

  Students ask and answer questions about job tasks, safety, materials, and tools.

- **Terms**

  Students learn to identify and pronounce the most common construction terms. Construction-related acronyms, abbreviations, and symbols are introduced.

- **Instructions**

  Students learn to identify and pronounce action verbs by responding to typical instructions from a foreman and giving instructions to others.

- **Forms**

  Students learn to identify and pronounce words and phrases on various forms (e.g., W-4, I-9, job application). During this portion of the presentation, students learn how to complete job-related forms correctly by entering information on sample forms.

GENERAL CONSTRUCTION

The 80-hour **General Construction** course provides students with fundamental construction information. This course covers the following topics:

- **Traffic Control**

  Students learn about the responsibilities of flaggers, as well as the legal liabilities, traffic control principles, proper flagging signals, job hazards, and PPE.

- **First Aid**

  This 8-hour introductory first aid course includes practical hands-on skills training. Students are presented with a CPR Certificate and a Basic First Aid Certificate upon successful completion of this course.

- **Tool and Material Recognition**

  Students learn to recognize the tools and materials frequently used in the construction field. Specific construction materials, such as reinforcement materials, fasteners, and nails are discussed.

- **Safety**

  Students are provided with OSHA's Construction Regulations for confined spaces, tools, welding, fire protection, fall protection, and safe work practices.

- **Power Tools**

  Students learn how to operate various power tools, such as grinders, drills, hammers, all-purpose saws, chain saws, and saber saws, as well as the proper sharpening techniques for these tools. During this presentation, students have an opportunity to operate various power tools. Other topics of discussion include fueling, accessories, cord selection, ground fault interrupters, and air hose repair.

- **Compaction**

  Students learn to identify the different soil types and the level of moisture in each type. Different types of compactors are discussed, as well as the proper compaction techniques.

- **Rigging**

  Students learn how to tie knots and hitches used in construction activities. The safety hazards associated with ropes, cables, slings, rigging hardware, lift capacities, load weights, and sling angles are discussed. During this presentation, students have an opportunity to rig various loads that are lifted with a crane.

- **Cutting and Burning**

  Students learn how to safely and efficiently perform oxy-acetylene cutting and burning procedures. During this presentation, students have an opportunity to set up cylinders, hook up regulators, and check for cylinder leaks.

- **Introductory Construction Math**

  Students learn how to identify and use measuring equipment, such as the builder's level and transit. In addition, students are introduced to the U.S. Customary System, Decimal System, and Metric System, and are taught how to mathematically convert each system.

- **Hazard Communication**

  Students are provided with information on the requirements of the OSHA Hazard Communication Standard.

HAZARD COMMUNICATION

The 4-hour **Hazard Communication** course introduces students to OSHA's Hazard Communication Standard, as it applies to the Construction Industry. Students learn guidelines for identifying chemical hazards and proper use of container labels, placards, and MSDSs. This course covers the following topics:

- **Hazard Communication Regulation**

  Students are provided with information on the major provisions of the OSHA Hazard Communication Program, including the scope of the standard, program requirements, and employer/employee rights and responsibilities.

- **Material Safety Data Sheets**

  Students learn how to work safely with hazardous chemicals by reading and interpreting information found on the MSDSs. Each section of a generic MSDS is discussed. Students are provided with a workbook containing MSDS samples for practice in finding pertinent information on the MSDS.

- **Chemical Labels and Lists**

  Students learn to identify critical information on the manufacturers' labels and lists.

- **Chemicals Used in Construction**

  Students learn about the chemical hazards associated with welding fumes, grinding dust, concrete dust, muriatic acid, and other products used during construction and environmental activities.

ASPHALT WORKER

The **Asphalt Worker** course provides hands-on training in the placement, spreading, and compaction of asphaltic materials. This course covers the following topics:

- **Safety**

  Students learn how to protect themselves and provide first aid. Potential hazards, such as heat stress, burns from molten asphalt, chemical fumes, and heat exhaustion are discussed.

- **Basics**

  Students are introduced to the asphalt terms and definitions, as well as the hand tools and equipment used in asphalt paving. The properties, uses, and mix designs of asphalt are discussed, as well as the responsibilities of the shovelers, rakers, screed operators, pavers, and roller operators.

- **Placing Methods**

  Students learn proper sub-grade preparation, measurement, and layout techniques. In addition, students learn the prime coat and tack applications, as well as how to competently calculate asphalt quantities, and hand spread, rake, and compact asphalt.

- **Repairing and Patching**

  Students learn asphalt repairing techniques, and the causes of pavement failure, such as alligator cracks and potholes.

LINE AND GRADE: HIGHWAY GRADE CHECKING

The 80-hour **Line and Grade: Highway Grade Checking** course provides the necessary skills for maintaining elevation and alignment control of heavy and civil construction activities. This course covers the following topics:

- **Measurement Systems**

  Students are introduced to the U.S. Customary System, Decimal System, and Metric System, and are taught how to mathematically convert each system.

- **Construction Line**

  Students learn the principles and uses of the construction line.

- **Measurement Techniques and Equipment**

  Students learn the proper methods of measuring horizontal and vertical distances, as well as how to detect and correct a level that is not adjusted properly. Differential leveling is discussed, in addition to hikeups and shot balancing techniques.

- **Views**

  Students learn the names of blueprint views and object visualization, as well as the terminology and definitions associated with drawings and blueprints.

- **Slope Expressions**

  Students learn slope expressions and the conversion methods for each expression.

- **Construction Referencing Systems**

  Students learn about reference stake recognition, in-line and right-angle referencing, reference point stake symbols and abbreviations, as well as swing-tie referencing procedures.

- **Roadway Slopes (Heavy and Highway)**

  Students learn the abbreviations and terminology for roadway slopes. The staking sequence on a road construction project is discussed, as well as the horizontal and vertical distance calculations from slope stakes and reference points. Horizontal and vertical distance calculations using different reference methods are also discussed.

- **Intermediate Slope Stakes**

  Students learn current slope building practices, interval staking techniques, as well as the temporary and permanent control methods.

- **The Roadway Surface**

  Students learn about the roadway surface and the materials that make up the surface. In addition, students learn how to calculate the material level location from reference point stakes, slope stakes, and intermediate slope stakes, as well as how to control staking as they work with grade sheets and superelevations.

- **Curb and Gutter Systems**

  Students learn grading methods of common types of curbing, such as hand formed, extruded, precast, and quarried systems.

- **Quantity Calculations**

  Students learn volume and area formulas, in addition to cross sections and cross-sectioning techniques.

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BASIC CONSTRUCTION PLAN READING

The **Basic Construction Plan Reading** course is specifically designed for students who want to develop their plan reading skills. This course can be taken in a structured classroom environment or as a correspondence course. Fourteen question and answer booklets cover different types of drawings, such as:

- **Civil Drawings**
- **Architectural Drawings**
- **Structural Drawings**
- **Mechanical Drawings**
- **Electrical Drawings**

CONCRETE PRACTICES AND PROCEDURES

The 80-hour **Concrete Practices and Procedures** course covers the following topics:

- **Safety**

  Students are taught proper lifting techniques, as well as the safety hazards associated with concrete work, such as trenching and shoring operations.

- **Construction Math**

  Students learn decimal and inch conversions, squaring principles, and quantity calculations.

- **Preparation, Placement, and Consolidation Procedures**

  Students learn subgrade preparation, elevation control, and layout techniques. During this presentation, students have an opportunity to place and consolidate concrete.

- **Finishing and Curing**

  Students learn the tool types, finishing procedures, and the curing and protection methods involved in concrete work.

- **Stripping and Cleanup**

  Students learn how to remove concrete forms without damaging newly placed concrete. During this presentation, students have an opportunity to practice form cleaning, stacking, and storage procedures.

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PRACTICES AND PROCEDURES OF MASON TENDING

The 80-hour **Practices and Procedures of Mason Tending** course introduces students to the following topics:

- **Safety**

  Students learn the worker protection rules in the OSHA Federal Register. Safety awareness and back injury prevention are discussed, as well as skin and health issues related to mason tending. Students become familiar with the common chemicals in masonry products by reviewing actual MSDSs.

- **Project Planning**

  Students learn how to plan a project properly to avoid unnecessary interruptions in project activities.

- **Scaffold Assembly**

  Students learn how to build a scaffold with a solid base, as well as erect and dismantle different types of scaffolding (e.g., frame and brace/tube and clamp). During this presentation, students have an opportunity to build a scaffold for circular and irregular terrains, and for inside and outside corner applications. Federal OSHA Regulations on scaffolding and ladders are discussed, as well as the safety rules for securing scaffolds.

- **Estimating and Proper Stocking**

  Students learn how to estimate block and brick quantities, as well as how to set up and stock block and brick at ground level and on the scaffold. In addition, students learn about stock cuts, factory made units at corners, control joints, and reinforcement and control joint material.

- **Mortar and Grout Mixing**

  Students learn the ingredients of mortar and grout, and how to properly mix the ingredients in the power mixer. During this presentation, students have an opportunity to follow step-by-step procedures for setting up the power mixer, mixing the mortar, shutting down and cleaning the mixer and mortar boxes.

- **Tending the Mason**

  Students learn about the mason's tools and the duties of a line tender. During this presentation, students have an opportunity to clean, wet, and mud down mortar boards and pans, as well as practice procedures for tempering stiff mortar.

- **Rough Terrain Forklift Operation**

  Students learn the different types of forklifts, and how to maintain and operate them. During this presentation, students have an opportunity to practice the initial steps for starting and operating a forklift, as well as demonstrate forklift operations with hands-on exercises.

- **Mortar, Grout, and Additives**

  Students learn to identify the different types and uses of mortar mixes, as well how to recognize and correct mortar mix problems. In addition, students learn how to estimate mortar and grout quantities, use different masonry cleaning techniques, and mix pigments for colored mortar.

- **Reinforced Masonry Construction**

  Students learn about reinforcing materials, accessories, and units used in masonry construction, in addition to the methods for controlling concrete cracks.

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TRENCH PROTECTION AND PRINCIPLES OF PIPE LAYING

The 80-hour **Trench Protection and Principles of Pipe Laying** course provides students with pipe laying information and hands-on exercises. This course covers the following topics:

- **Trenching and Shoring Safety**

  Students learn about three protective systems, as well as how to determine who should inspect an excavation and how often. In addition, students learn how to identify the soil characteristics for Type A, B, and C soils, and the warning signs of a previous excavation or unmarked utility.

- **Pressure Piping Techniques**

  Students learn to identify pipe tools and parts, as well as how to join pipe sections using mechanical, heat fusion, and push-on joint connections. During this presentation, students have an opportunity to perform hydrostatic testing, tapping, and assembling of water service connections that are under pressure. Also, the responsibilities of each pipe crew member are discussed.

- **Gravity Flow Piping Systems**

  Students learn about the different types of pipes and their accuracy requirements, as well as the installation techniques for manholes, drop inlets, sanitary sewer cleanouts, and laterals. During this presentation, students have an opportunity to install sanitary and storm sewers. Also, students practice the repair and tie-in methods, and the procedures for pneumatic testing.

- **Utility Line and Grade**

  Students are introduced to the line and grade terms, as well as common referencing methods. In addition, students learn how to use different measurement control systems, how to control alignment and elevation using lasers, levels, and transits, and how to calculate distances using the stationing system.

ENVIRONMENTAL COURSES

ENVIRONMENTAL LABORER PREPARATORY

The 40-hour **Environmental Laborer Preparatory** course covers the following topics:

- **Overview of Environmental Cleanup**

  Students learn the importance of environmental certifications, as well as how to overcome learning barriers. The career paths of environmental laborers are discussed.

- **Learning Technical Information**

  Students learn that questioning is the most important skill when learning technical information. Various types of learning questions are presented. In addition, students learn the importance of paragraphs and how to organize them, as well as how to write down key words and phrases. Students learn how to locate important information and find the meaning of technical terms in the environmental worker course manuals. The importance of visual aids is explained. During this presentation, students have an opportunity to relate past experiences with the environmental course topics.

- **Following Procedures**

  Students learn why SOPs are important, and how to find procedural information in the environmental worker course manuals. During this presentation, students have an opportunity to summarize a large portion of an environmental manual, so they learn to rely less on the instructor and more on the team. Students learn to recognize and overcome obstacles on their own, as they organize and present a team summary to the class. The formulas for solving environmental math problems are presented, and students have an opportunity for practice exercises.

- **Creating a Test**

  Students create a test from an environmental manual and then verify the test answers. During this presentation, students have an opportunity to discuss portions of the environmental certification tests.

- **Planning the Next Steps**

  Students have an opportunity for one-on-one counseling to discuss their career plans, and/or to evaluate the Environmental Laborer Preparatory course.

HAZARD COMMUNICATION

The 4-hour **Hazard Communication** course introduces students to OSHA's Hazard Communication Standard, as it applies to the Construction Industry. Students learn guidelines for identifying chemical hazards and proper use of container labels, placards, and MSDSs. This course covers the following topics:

- **Hazard Communication Regulation**

  Students are provided with information on the major provisions of the OSHA Hazard Communication Program, including the scope of the standard, program requirements, and employer/employee rights and responsibilities.

- **Material Safety Data Sheets**

  Students learn how to work safely with hazardous chemicals by reading and interpreting information found on the MSDSs. Each section of a generic MSDS is discussed. Students are provided with a workbook containing MSDS samples for practice in finding pertinent information on the MSDS.

- **Chemical Labels and Lists**

  Students learn to identify critical information on the manufacturers' labels and lists.

- **Chemicals Used in Construction**

  Students learn about the chemical hazards associated with welding fumes, grinding dust, concrete dust, muriatic acid, and other products used during construction and environmental activities.

UNDERGROUND STORAGE TANK REMEDIATION

The 24-hour **Underground Storage Tank Remediation** course is designed for workers involved in the cleanup of leaking USTs. This course provides specific information on UST removal and enclosure. Emphasis is placed on the use of air monitoring instruments, bonding and grounding, purging and inerting, and confined space work practices. This course covers the following topics:

- **Introduction to Underground Storage Tanks**

  Students learn about USTs and the reasons why they leak. Current regulations and problems associated with leaking USTs are discussed.

- **Health Effects**

  Students learn about the physical and health hazards associated with UST remediation.

- **Confined Space Entry**

  Students learn how to identify and recognize potential hazards associated with confined spaces. Emphasis is placed on recognizing and controlling atmospheric hazards during confined space entry.

- **Health and Safety During Underground Storage Tank Remediation**

  Students use the information presented in the previous presentations, and apply it to the health and safety issues associated with UST remediation. Precautions and procedures for tank closing and removal are discussed. During this presentation, students have an opportunity for hands-on exercises with atmospheric testing, vapor-freeing, bonding and grounding, and tank cleaning.

ASBESTOS ABATEMENT WORKER

The 40-hour **Asbestos Abatement Worker** course focuses on the hazards of asbestos, the specific procedures used on the job, and the legal rights of the workers. During this course, students have an opportunity for group discussions and hands-on exercises. This course covers the following topics:

- **Asbestos and Its Uses**

  Students learn where asbestos is found, the types and uses of asbestos, and the measurement of asbestos fibers.

- **Health Effects of Asbestos**

  Students learn how asbestos enters and affects the body. The harmful effects on the respiratory system are discussed, as well as several asbestos-related diseases.

- **Medical Monitoring and Surveillance**

  Students learn why the medical surveillance programs and the pre-placement exams are necessary. The specific tests involved in medical monitoring are discussed, as well as OSHA's requirements for medical record keeping.

- **Legal Rights and Asbestos Abatement Regulations**

  Students learn about the Occupational Health and Safety Act of 1970, employee workplace rights and responsibilities, special rules for construction, NLRA (Section 143) workers' compensation rights, toxic tort actions, and asbestos abatement regulations, as well as the employer, employee, and union liability.

- **Personal Protective Equipment and Clothing**

  Students learn the types of PPE and the clothing worn on asbestos abatement projects. Types of respiratory protection are discussed, as well as the protection factors and how they relate to specific respirators. In addition, students learn the proper care, inspection, and cleaning methods, as well as proper fit testing techniques associated with respiratory protection.

- **Safe Work Practices, Engineering Controls, and General Site Safety**

  Students learn about safe work practices, engineering controls, and general site safety. The proper use of ladders and scaffolds are discussed, as well as how to avoid slips, trips, and falls. Students learn about fire safety and the use of control measures on asbestos abatement projects.

- **Recommended Practices for the Use of Negative Pressure Air Filter Systems**

  Students learn about the negative pressure enclosure and the portable HEPA filtered negative pressure unit. The proper set up and maintenance of a negative pressure system are discussed.

- **Preparing the Work Area and Setting Up the Decontamination Unit**

  Students learn the necessary steps in preparing the work area and setting up the decontamination unit, in addition to the tools and materials needed.

- **Asbestos Abatement Techniques**

  Students learn specific abatement techniques, including encapsulation, enclosure, and the proper procedures for using glove bags. Wet removal techniques are discussed, as well as the steps required for cleaning up and preparing asbestos waste for disposal.

- **Air Monitoring**

  Students learn sampling methods, such as air sampling, bulk sampling, and wipe sampling. The types of analytical methods used in sampling are discussed, as well as the sampling procedures for an abatement project from inception to final clearance.

- **Hazard Communication Regulations**

  Students learn about OSHA's Hazard Communication Standard for a better understanding of the employer's written Hazard Communication Program and the MSDSs.

LEAD ABATEMENT WORKER

The 32-hour **Lead Abatement Worker** course provides students with information on lead abatement methods for safely removing various materials containing lead. Topics of discussion include abatement problems and possible solutions, current regulations, worker safety, as well as preparation, containment, and cleanup of lead contaminated areas. Students have an opportunity to practice hands-on removal procedures. This course covers the following topics:

- **Lead and Its Uses**

  Students learn about environmental and occupational exposures, in addition to the methods for determining if lead is present.

- **Regulations and Workers Legal Rights**

  Students are provided with information regarding their personal rights and responsibilities under OSHA, EPA, and the Medical Monitoring Program.

- **Health Effects of Lead**

  Students learn how lead enters and affects the body, as well as how to avoid heat stress, cold stress, and other hazards.

- **Personal Protective Equipment**

  Students learn how to protect themselves from lead exposure using PPE. Various types of respirators are discussed, as well as their protection factors. During this presentation, students have an opportunity to fit test, clean, maintain, and store respirators properly.

- **Work Practices, Abatement Methods, and Disposal Procedures**

  Students learn the importance of containing and disposing waste materials, as well as how to prepare the job site prior to lead abatement. During this presentation, students have an opportunity to build a decontamination chamber, as well as operate heat guns, HEPA sanders, and mechanical devices for abating lead.

- **Hazard Communication Regulations**

  Students learn about OSHA's Hazard Communication Standard for a better understanding of the employer's written Hazard Communication Program and the MSDSs.

- **Inspector and Inspection Reports**

  Students learn about the process lead inspectors utilize, as well as the makeup of lead inspection reports.

HAZARDOUS WASTE WORKER

The 80-hour **Hazardous Waste Worker** course covers the following topics:

- **Hazard Recognition and Identification**

  Students learn how to recognize and identify hazards associated with hazardous waste operations. General categories of hazards (e.g., flammables, explosives, corrosives, reactives, radioactive materials, biological materials) are discussed.

- **Hazard Communication Regulations**

  Students learn about OSHA's Hazard Communication Standard, and how it applies to the Environmental Cleanup Industry. During this presentation, students are shown how labels and the MSDSs aid in hazard identification.

- **Health Effects**

  Students learn about the history of workplace hazards. Beginning at the cellular level, students learn how chemicals enter the body. Acute and chronic health effects are discussed.

- **Legal Rights**

  Students learn about the laws and regulations governing health and safety protection in the workplace. Applicable laws or legal protections for workers on the job are discussed.

- **Personal Protective Equipment**

  Students learn how PPE prevents internal and external contamination. Donning and doffing procedures are discussed, followed by hands-on exercises. In addition, students learn how to select and use respirators and chemical protective clothing.

- **Decontamination**

  Students learn about the equipment for decontamination. Maximum and condensed decontamination procedures are discussed and reinforced with field exercises.

- **Site Safety and Health Plans**

  Students learn about the general components of Safety and Health Programs, as required by 29 CFR 1910.120(b). Topics of discussion include the Organizational Structure, Workplan, Health and Safety Plan, Health and Safety Training Program, Medical Surveillance Program, and SOPs.

- **Material Handling, Storage, and Transportation**

  Students learn the proper procedures for safely handling drums and other hazardous waste containers.

- **Safe Sampling Techniques and Air Monitoring**

  Students learn safe sampling guidelines for sampling drummed and unidentified waste, in addition to air monitoring requirements. Several drum opening techniques are discussed, as well as drum opening equipment designed to maximize worker safety.

RADIATION WORKER

The 24-hour **Radiation Worker** course is designed for students who are involved in the cleanup of radiologically contaminated waste sites. This course is an introduction to the basic concepts of ionizing radiation and its attending hazards. Emphasis is placed on the use of instruments, survey techniques, and control measures. This course covers the following topics:

- **Radiation and Its Properties**

  Students learn the properties of radiation. The structure of matter, radioactivity, radiation, and radiological units of measurement are discussed.

- **Sources of Radiation Exposure**

  Students learn the major sources of radiation, including the natural sources (e.g., cosmic and terrestrial radiation) and man-made (e.g., x-ray) sources.

- **Health Effects of Radiation**

  Students learn why radiation guides and exposure standards exist. Beginning at the cellular level, students learn how radiation affects the body. The acute and chronic biological effects of radiation are discussed.

- **Control Measures**

  Students learn how to reduce their exposure through time, distance, and shielding. Laboratory and calculation exercises reinforce the lecture presentation.

- **Radiological Posting**

  Students learn the procedures for posting radiologically controlled areas. The setting up of area control points using barrier ropes are discussed, as well as step-off pads, and establishing perimeter identification.

- **Personal Protective Equipment**

  Students learn how PPE prevents internal and external contamination. Donning and doffing procedures are presented, followed by hands-on exercises.

- **Radiation Detection Instruments**

  Students learn the types of radiation instruments and the principles of operation. The use of radiation detection instruments for personal monitoring and surveying are discussed. In addition, students learn about fixed monitoring devices (e.g., remote area monitors, continuous air monitors). Laboratory and hands-on exercises reinforce the lecture presentation.

- **Personal Dosimetry**

  Students learn the common types of dosimetry, as well as the advantages and limitations of each. The recommended procedures for wearing and using film badges, pocket ion chambers, and TLD badges are discussed.

REFRESHER COURSES

ASBESTOS ABATEMENT WORKER REFRESHER

The 8-hour **Asbestos Abatement Worker Refresher** course is designed to meet the refresher course requirements of the EPA and state regulations. Students are presented with updated information regarding new regulations, equipment, work procedures, and other related information. This course covers the following topics:

- **Types of Asbestos**

  Students review where asbestos is found, the types and uses of asbestos, and the measurement of asbestos fibers.

- **Health Effects of Asbestos**

  Students review how asbestos enters and affects the body. The harmful effects on the respiratory system are also reviewed, as well as several asbestos-related diseases.

- **Legal Standards**

  Students review the legal aspects of asbestos abatement. The OSHA - Asbestos Standard for Construction 29 CFR 1926.58 TN; EPA - National Emission Standards for Hazardous Air Pollutants (NESHAPS); EPA - Toxic Substance Control Act are also reviewed, as well as state regulations, licensing, notification, record keeping, exposure limits, air sampling, control measures, engineering controls, hygiene facilities, work practice controls, PPE, employee training, and medical testing.

- **Medical Surveillance**

  Students review the necessity of a medical surveillance program, as specified under the OSHA Construction Standard. Initial exams, annual exams, termination of employment exam, record keeping, reasons for testing, and physical exams are also reviewed.

- **Respiratory Protection**

  Students review the four basic respirators and their corresponding protection factors. Proper fit testing techniques are also reviewed, as well as the inspecting, cleaning, and disinfecting techniques.

- **Work Practices**

  Students review topics related to the actual work site. The procedures for preparing the work area and setting up the decontamination unit are also reviewed. Other topics of discussion include controlling asbestos exposure during removal, wet removal techniques, cleaning up the work area, waste disposal, sampling and analytical methods for asbestos abatement, safety and health hazards, and fire safety.

LEAD ABATEMENT WORKER REFRESHER

The 8-hour **Lead Abatement Worker Refresher** course is presently under development. It will review information on the following topics already covered in the Lead Abatement Worker course.

- **Health Effects**

  Students review health hazards associated with lead.

- **Regulations and Workers Legal Rights**

  Students are provided with updated information on lead regulations and their legal rights.

- **Personal Protective Equipment**

  Students review the types of PPE.

- **Work Practices, Abatement Methods, and Disposal Procedures**

  Students are provided with updated information on work site practices. In addition, students will have an opportunity to discuss some of their work experiences with other students in the class.

HAZARDOUS WASTE WORKER REFRESHER

The 8-hour **Hazardous Waste Worker Refresher** course reviews some of the information provided in the 80-hour Hazardous Waste Worker course. Also, new regulations, technologies, and advancements are covered. During this presentation, skilled hazardous waste workers have an opportunity to discuss their work experiences and ideas. This course covers the following topics:

- **Hazardous Waste Operation Overview**

  Students are provided with an overview of the Hazardous Waste and Emergency Response Standard (OSHA CFR 1910.120). Some of the information covered in the 80-hour Hazardous Waste Worker course is reviewed, in addition to all of the refresher topics specified in the OSHA standard.

- **New Technologies**

  Students are provided with information on innovative technologies. New regulations are presented, as well as the revisions to the NPL Superfund sites. In addition, students have an opportunity to discuss work experiences and any subject material presented in this course.

- **Other Topics**

  This course is revised annually. During the second half of the course, new procedures and practices are discussed, as well as new emerging technologies and equipment. Confined space entry and groundwater information was added to this year's version.

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SUPERVISORY COURSES

ASBESTOS ABATEMENT SUPERVISOR

The 40-hour **Asbestos Abatement Supervisor** course builds on the information provided in the 40-hour Asbestos Abatement Worker course. Emphasis is placed on enhancing leadership and communication skills. This course covers the following topics:

- **Worker's Course Topics**

  Students review the types of asbestos and the measurement of asbestos fibers. Other topics of discussion include health effects, legal standards, respiratory protection, protective clothing, encapsulation, enclosure, glove bag procedures, preparing the work area and setting up the decontamination unit, controlling asbestos exposure during removal, cleaning up the work area, waste disposal, medical surveillance, as well as sampling and analytical methods for asbestos abatement.

- **Safety and Health Hazards (Other than Asbestos)**

  Students review general safety and health hazards, as well as the supervisor's role of ensuring a safe and healthy workplace.

- **Contracts**

  Students learn what a contract is, as well as the types and contents of contracts.

- **Insurance and Liability**

  Students learn about the kinds of lawsuits and legal issues that can arise from asbestos abatement work. Different types of insurance coverages are discussed, such as workers' compensation insurance, claims made insurance, occurrence insurance, performance bonding, and general liability insurance.

- **Respirators -- Legal Requirements**

  Students learn about MARPs. Information on how to conduct qualitative irritant smoke respirator fit testing is presented, as well as its respective protocol.

- **Record Keeping for Supervisors**

  Students learn about the record keeping requirements for abatement sites. The supervisor's involvement in fulfilling these requirements are discussed.

- **Supervision**

  Students learn the importance and specific methods of effective supervision. Setting goals, problem solving, and worker performance are discussed, as well as employee training, dealing with poor performance, and showing respect to workers.

- **Air Monitoring**

  Students learn the different types and methods of air sampling. The procedures for sampling before, during, and after asbestos abatement projects are presented. In addition, OSHA Asbestos Standards for the Construction Industry (Part 1926) are discussed.

- **Other Topics**

  Additional information provided during the course includes the physical characteristics of asbestos and materials containing asbestos, as well as health effects, PPE, state-of-the-art work practices, personal hygiene, and medical monitoring.

ASBESTOS ABATEMENT SUPERVISOR REFRESHER

The 8-hour **Asbestos Abatement Supervisor Refresher** course provides supervisors with updates to important information concerning new regulations and advancements in asbestos abatement technology. This course covers the following topics:

- **Types of Asbestos**

  Students review where asbestos is found, the types and uses of asbestos, and the measurement of asbestos fibers.

- **Health Effects of Asbestos**

  Students review how asbestos enters and affects the body. The harmful effects on the respiratory system are also reviewed, as well as several asbestos-related diseases.

- **Legal Standards**

  Students review the legal aspects of asbestos abatement. The OSHA - Asbestos Standard for Construction 29 CFR 1926.58 TN; EPA - NESHAPS; EPA - Toxic Substance Control Act are also reviewed, as well as state regulations, licensing, notification, record keeping, exposure limits, air sampling, control measures, engineering controls, hygiene facilities, work practice controls, PPE, employee training, and medical testing.

- **Medical Surveillance**

  Students review the necessity of a medical surveillance program, as specified under the OSHA Construction Standard. Initial exams, annual exams, termination of employment exam, record keeping, reasons for testing, and physical exams are also reviewed.

- **Respiratory Protection**

  Students review the four basic respirators and their corresponding protection factors. Proper fit testing techniques are also reviewed, as well as the inspecting, cleaning, and disinfecting techniques.

- **Work Practices**

  Students review topics related to the actual work site. The procedures for preparing the work area and setting up the decontamination unit are also reviewed. Other topics of discussion include controlling asbestos exposure during removal, wet removal techniques, cleaning up the work area, waste disposal, sampling and analytical methods for asbestos abatement, safety and health hazards, and fire safety.

- **Respirator Protection Programs**

  Students learn more about MARPs. Information on how to conduct qualitative irritant smoke respirator fit testing is presented, as well as its respective protocol.

- **Record Keeping**

  Students are provided with updated information on the record keeping requirements for asbestos abatement sites. The supervisor's involvement in fulfilling these requirements are discussed, as well as the OSHA requirements for record keeping - 29 CFR 1926.58, EPA requirements, such as NESHAPS, and any other current state requirements.

- **Changes in Federal and/or State Regulations**

  Students are provided with updated information on new federal and state regulations concerning asbestos abatement projects.

- **New Techniques and/or Technologies**

  Students are provided with updated information on new techniques and technologies.

- **Other Topics**

  Students learn about recent developments in the Environmental Industry.

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FOREMAN PREPAREDNESS

The 40-hour **Foreman Preparedness** course provides the prospective foreman with techniques associated with leadership in the Construction Industry. This course covers the following topics:

- **Communication**

  Students learn the steps in the communication process, including practical listening techniques. The controls that influence effective communication on the job are discussed, as well as the barriers that block a person's ability to communicate.

- **Construction Math**

  Students learn squaring and layout methods. The basic slope formula is introduced. Survey procedures and project staking protocols are discussed.

- **Project Organization and Documentation**

  Students learn about the construction project structure from the project owner to the subcontractor. The types and necessity of project documentation are discussed, as well as the purpose of concise daily reports.

- **Health and Safety Recognition**

  Students use the OSHA Construction Standards book to locate specific regulations concerning health and safety. The major affects of heat stress, hypothermia, and frost bite are discussed, as well as the guidelines for improving site safety records.

- **Dealing With People**

  Students learn why dealing with people is a critical part of the foreman's job, and some practical and appropriate approaches are presented.

- **Problem Solving**

  Students learn how to apply a six-step problem-solving process to some actual job site situations. The differences between a problem and a symptom are discussed.

LEAD ABATEMENT SUPERVISOR

The **Lead Abatement Supervisor** course provides abatement supervisors with information on their responsibilities during abatement projects. This course covers the following topics:

- **Leadership Techniques**

  Students learn about management and employee relationships. Communicating and listening skills are discussed, as well as how to increase worker productivity.

- **Project Documentation**

  Students learn the importance of keeping a daily log, making mental and written notes, in addition to controlling inventory.

- **Air Monitoring**

  Students learn the different types and methods of air sampling. The procedures for sampling before, during, and after lead abatement projects are presented.

- **Inspections**

  Students learn how to deal with inspectors, and how to interpret results from the XRF instrument data.

- **Insurance and Liability**

  Students learn about the kinds of lawsuits and legal issues that can arise from asbestos abatement work. Different types of insurance coverages are discussed, such as workers' compensation insurance, claims made insurance, occurrence insurance, performance bonding, and general liability insurance.

HAZARDOUS WASTE SUPERVISOR

The 16-hour **Hazardous Waste Supervisor** course builds on the Hazardous Waste Worker course. This course covers the following topics:

- **Leadership**

  Students learn the basic principles of leadership, supervision, and effective communication. During this presentation, students have an opportunity to participate in group exercises and discussions.

- **Site Safety and Health Plans**

  Students are provided with information on the components of the Site Safety and Health Plan, including the Organizational Structure, Workplan, Health and Safety Training Program, Medical Surveillance Program, and SOPs.

- **Emergency Response**

  Students learn how to prepare for an emergency, and the fundamentals of developing an emergency response plan. During this presentation, students have an opportunity to discuss the general theory of emergency response.

- **Personal Protective Equipment**

  Students learn how PPE prevents internal and external contamination. Selection and use of respirators are discussed, as well as chemical protective clothing.

- **Media Relations**

  Students learn the fundamentals of maintaining good relationships with the community and media.

- **Rights and Remedies - Supervisors Issues**

  Students learn about the laws and regulations governing health and safety in the workplace. A generalized overview of the OSHA, SARA, NLRA, and other applicable laws and legal protections are discussed.

HAZARDOUS WASTE WORKER OPERATIONS

The 45-hour **Hazardous Waste Worker Operations** course provides information to all individuals involved in hazardous waste cleanup. It is designed primarily for managerial personnel, including but not limited to, contractor personnel, government officials, and union representatives. This course covers the following topics:

- **Hazard Recognition**

  Students learn about toxic chemicals, hazards on the job site, hazard communication, hazardous chemical labels, DOT symbols, MSDSs, and chemical fact sheets.

- **Legal Rights and Responsibilities of Workers**

  Students learn about the legal rights and responsibilities of workers. The laws pertaining to hazardous waste cleanup, including the OSHA 1910.120; OSHA 1910.1200; SARA; and the NLRA are discussed.

- **Health Effects**

  Students learn about chemical exposures, acute and chronic health effects, heat and cold stress, monitoring vital body signs, routes of entry, basic physiology, as well as biological, physical, and noise hazards.

- **Personal Protective Equipment**

  Students receive classroom demonstrations on donning and doffing PPE. During this presentation, students have an opportunity to practice the donning and doffing procedures with full-face respirators, SCBA, and chemical protective equipment.

- **Site Safety and Health Plans**

  Students use a model Site Safety and Health Plan to learn the written Site Safety and Health Plan requirements for hazardous waste cleanup projects.

- **Decontamination Procedures**

  Students learn the purpose and methods of decontamination procedures. During this presentation, students have an opportunity to perform hands-on training exercises at a mock hazardous waste site.

- **Safe Use of Field Equipment**

  Students have the opportunity to suit up in Levels A, B, and C equipment, as well as perform hands-on exercises at a mock hazardous waste site.

- **Sampling Techniques**

  Students learn safe sampling guidelines for sampling drummed and unidentified waste.

- **Emergency Procedures and Medical Surveillance**

  Students learn about the Emergency Site Plans and the procedures for Emergency Planning. During this presentation, emphasis is placed on preventing emergency situations.

- **Engineering Controls**

  Students learn how to reduce hazardous waste exposures, illnesses, and/or injuries using Engineering Controls.

- **Superfund and Community Relation**

  Students learn about the Superfund process beginning with the discovery of the site, through the assessment and remediation stage. The purpose and goals of an effective Superfund Community Relations Program are discussed. During this presentation, emphasis is placed on the Community Right to Know/SARA Title III, and how the contractor and government officials can relate to the community.

Improve Your Reading Skills for Free: Laborers-AGC Offers New 'Learn-At-Home' Video

They are there if you need them . . . The Learn-At-Home Program can also be adopted by local training funds for classroom instruction, review, and support.

Think you don't have to read much to be a Laborer? Maybe that was true once, but not anymore.

In the future, you'll need more and more skills to compete for the jobs coming down the road for LIUNA members. That means learning—book learning, too. Laborers-AGC has lots of new training courses from basic construction to environmental clean-up. Learning new skills will help you work more hours and earn more money. But to take these training courses for the jobs of tomorrow, you will have to be able to read well.

For example, we see lots of jobs and lots of hours for Laborers trained in asbestos and hazardous waste removal. These job sites can be dangerous. Site safety plans, warning signs, and material safety data sheets are provided for worker protection. That means being able to read to watch out for hazards and to learn the right way to work safely.

He has walked in your shoes . . . Wally "Famous" Amos hosts the Reading Section of the KET/GED Series and the pre-GED series "Another Page." Amos, founder and president of Famous Amos Chocolate Chip Cookies, was a high school dropout who earned his GED certificate.

With more emphasis on reading skills, Laborers-AGC is pleased to announce an exciting new video program that will help you learn to read better. You can learn right in your own living room, when you have the time, with reading courses you play on your VCR. It's the Laborers-AGC "Learn-At-Home Program," and it's happening now!

The Learn-At-Home Program is free to all LIUNA members who work in construction and want to improve their reading skills. To get started, or to find out more about the program, all you have to do is call **1-800-852-5277.**

The program includes three different reading courses. You will start at the best place for you. When you call the toll-free number, a friendly program advisor will help you figure out the best place for you to begin.

The next thing you know, the courses will arrive at your home, and you will be ready to improve your most important skill.

IMPROVE YOUR READING . . . AT HOME ON YOUR VCR

A Great New Video Program From Laborers-AGC

Free —Call 1-800-852-5277 Today and Get Started!

Anyone can benefit from learning to read better. How about you? What are you waiting for? Call today, and take advantage of being a Laborer. This program is for you! ■

Improve Your Work Skills

Pipe Laying, Mason Tending and Concrete are still the "Bread and Butter" jobs for construction Laborers.

Watch for the next issue of *The Laborer* for more information on the Construction Skills Training Program that Laborers-AGC will offer this Fall. ■

REVIEW

LABORERS AGC EDUCATION & TRAINING FUND

LIUNA MEMBERS SPEAK OUT ON THE LEARN-AT-HOME PROGRAM

Before the Laborers-AGC Education and Training Fund offered the Learn-At-Home video program, there was one question: "Would the membership like it?"

The program got off to a great start. The number of laborers participating in the program steadily rose after its inception, and Fund trustees recognized this as a good sign. But they wanted to know more. Trustees decided it was time to find out what the members really thought about using the tapes.

The Laborers-AGC, through an independent evaluator, has conducted a survey of more than 500 Learn-At-Home Program participants. What follows is a breakdown of how the membership responded to various questions regarding the program.

Q **How did you find out about the program?**

ANSWER: Almost 79 percent found out through *The Laborer*. A smaller number heard about the program through the union hall. With this in mind, the Laborers-AGC has developed a videotape that will be shown at local union meetings across the U.S. and Canada.

Q **What level was right for you?**

ANSWER: 75 percent of our members used Level 1; 25 percent used Level 2; 20 percent used Level 3. (These numbers include members who used more than one tape).

Q **How old are you?**

ANSWER: Age was not a problem. Though all ages used the course, persons ages 36 to 40 constituted the largest number of participants. The next three age groups were just about tied for second largest: 30 to 35 years old; 41 to 45 years old; and 46 to 50 years old.

Q **Did experience as a laborer affect who did/did not participate?**

ANSWER: The largest single user group (37 percent) was members with more than 25 years experience as a laborer. Close behind were 16 to 25 years of experience, 1 to 5 years of experience, and 6 to 10 years of experience.

Q **How much did the tapes help you?**

ANSWER: I can read better; I feel better about myself; I can continue my education; I have increased confidence.

Q **Are you satisfied with the program?**

ANSWER: 99 percent of the members suggested they were happy or very happy with the program! More than 80 percent said that the program had changed their lives! More than 90 percent believed that the tapes had improved their reading and had helped them to feel good about themselves. More than 30 percent had involved other family members.

What do these results mean? First, that the Learn-At-Home Program is a success. Laborers of all ages and levels of work experience and education experience have participated in the program. The overwhelming majority reported that they are happy with the program. They believe that the program has had a beneficial effect on their lives and the lives of family members.

We would again like to thank all the members involved for answering the questions. Their responses showed great thought and honesty. Though we did not have the space to include all the questions asked, your remarks and suggestions about the program will be used to improve the process. The Laborers-AGC would like to give a special thanks to the family members for their help and support.

For those members who have not taken advantage of this program, please listen to your fellow brothers and sisters:

Get involved; improve your reading skills! It is free and no one will know but you.

Just call (in the U.S.) 1-800-852-5277 or (in Canada) 1-800-253-4663.

New Course Prepares Laborers For Environmental Training

Webster's defines prepare: "to make ready beforehand . . . to put in a proper state of mind . . . to get ready."

The Laborers-AGC's new Environmental Laborer Preparatory Course is designed to get you, the member, ready for environmental training.

Right now, your local training fund or regional training site offers courses that certify you in asbestos and lead abatement, and hazardous waste removal. In addition, new courses dealing with radiation protection and leaking underground storage tanks will be available in 1992.

The Environmental Laborer Preparatory Course will give you the advantage needed to successfully complete these courses. Developed under a Department of Education (DOE) Workplace Literacy Grant, the "Prep" Course will overview:

- the environmental cleanup industry
- environmental laborer career path
- courses in asbestos, lead, and hazardous waste

Overcoming Barriers

Take a second and think back to your school days. For many people, this memory of the classroom is not a positive one. In adults these attitudes about learning become barriers to personal growth.

Everyone will experience "learning barriers" during some point in their life. Family and job commitments, time away from school, difficulty reading and understanding information, and anxiety about taking tests, are road blocks to continuing education.

For many members, learning barriers maybe keeping them from attending one of the environmental training courses. Concerns about the increased classroom work, the need to read and study technical information, and testing for certification are limiting their careers. The Prep Course was developed to help laborers overcome these barriers.

Laborers-AGC Assistant Director, John LeConche, has been involved with this project from the start. As Project Director under the DOE Grant, LeConche has seen the course develop from the original idea. "The environmental courses are technical in nature and require written tests to gain certification. The Prep Course will help sharpen the classroom skills of our members. It will also take the mystery out of taking written tests. Through this course more laborers can get involved in the growing field of environmental cleanup."

Benefits Beyond The Classroom

Many of the skills learned in the class will benefit the member well after their training is completed. The course design promotes:

- active involvement
- the ability to ask the "right" question
- finding the most important information in what is read
- how to scan documents
- working in groups
- career planning

Initially, the Prep Course will be offered at three training funds as part of the DOE Grant Project. The pilot sites are: Kentucky Laborers Training Trust Fund in Lawrenceburg, KY; New England Laborers Training Academy in Pomfret Center, CT; and West Virginia Laborers Training Trust Fund in Mineral Wells, WV.

Once the Grant Project is completed (October 1992) the Environmental Prep Course will be available to all local training funds.

The first presentation of the Environmental Laborers Preparatory Course was held in January at the New England Laborers Training Academy. Laborers from across New England took part in the five day presentation.

All of the trainees had worked primarily in construction, with only one having gone through the asbestos training class. Most knew little to nothing about the environmental training available to them. The length of membership in LIUNA varied from three to fifteen years.

The success of this pilot presentation went beyond initial expectations. From the start, the Course format actively involved the trainees. The enthusiastic response to this approach continued throughout the week, as the trainees challenged each other during the different group exercises.

The real test of success came from laborers comments. "I was glad to get a chance to practice the skills taught in the Prep Course before taking the other environmental programs." The manuals used in the Prep Course are the same manuals used in the asbestos, lead, and hazardous waste courses. "It was important to see and use these manuals." When asked for additional suggestions about the presentation one trainee summed up the experience best, "To make sure all laborers take this program." By the end of the week all had signed up for the next available environmental worker course.

AN INVITATION TO CONSTRUCTION LABORERS . . . .

Everyday we read and hear stories about the pollution of our land, air, and water. The public demand for a major cleanup effort will cost billions of dollars and create new job opportunities in:

- asbestos abatement
- lead abatement
- hazardous waste removal

Your local or regional training center offers courses that certify you to work in this growing industry. To prepare you for this training, the Laborers-AGC Environmental Laborer Preparatory Course will:

- introduce you to the environmental cleanup industry,
- sharpen your ability to learn technical information, and
- prepare you for courses in asbestos and lead abatement and hazardous waste removal.

If you are interested in upgrading your skills for the future, enroll today in the Environmental Laborer Preparatory Course.

In Kentucky call David Vinson 502-8393155
In New England call Gerry Lepore, 203-974-1455
In West Virginia call Terry O'Sullivan, 304-489-9665

Laborers-AGC and its affiliate training funds do not discriminate in administration of their services on the basis of race, religion, sex, national or ethnic origin.